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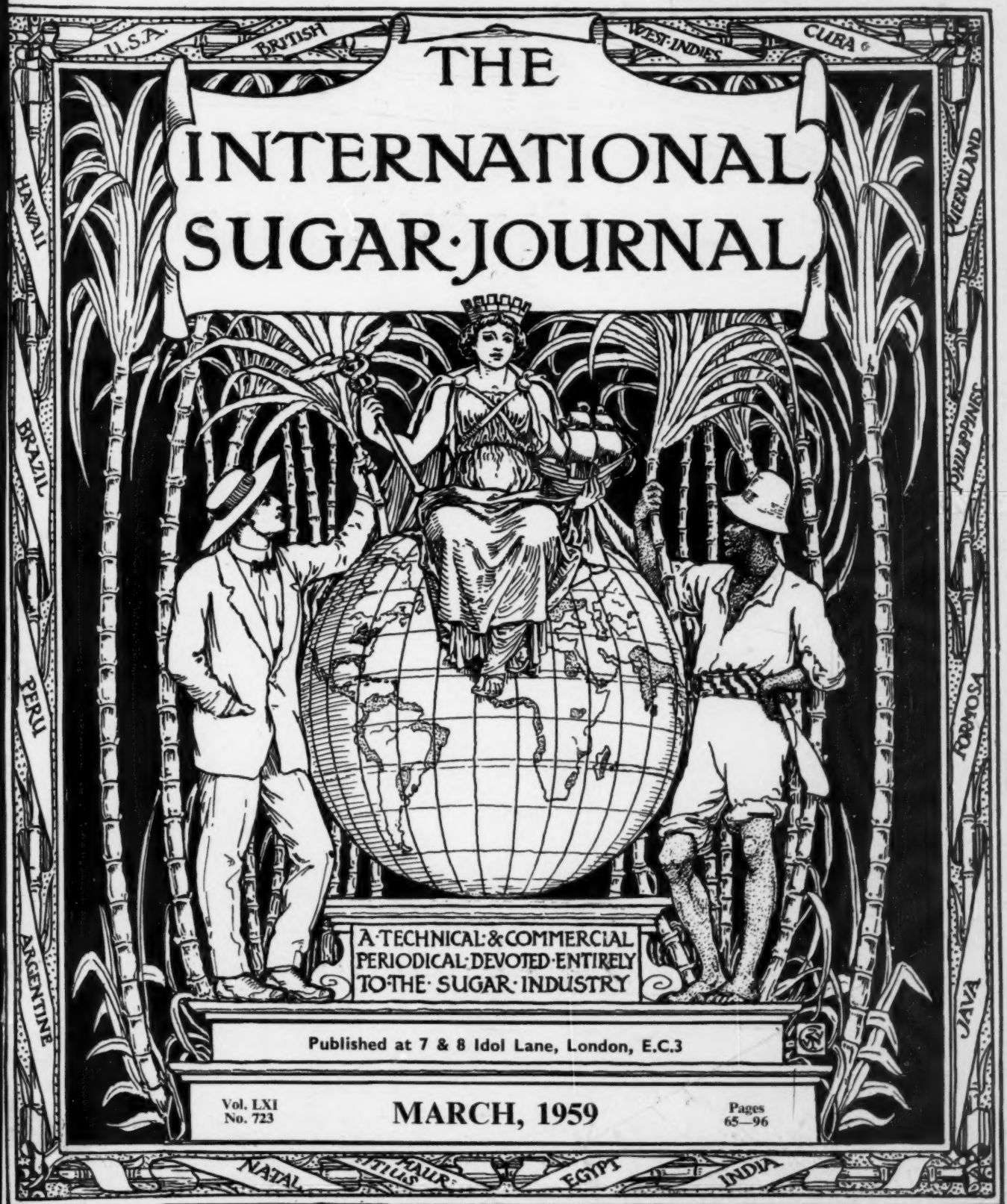

Published at 7 & 8 Idol Lane, London, E.C.3

Vol. LXI
No. 723

MARCH, 1959

Pages
65—96

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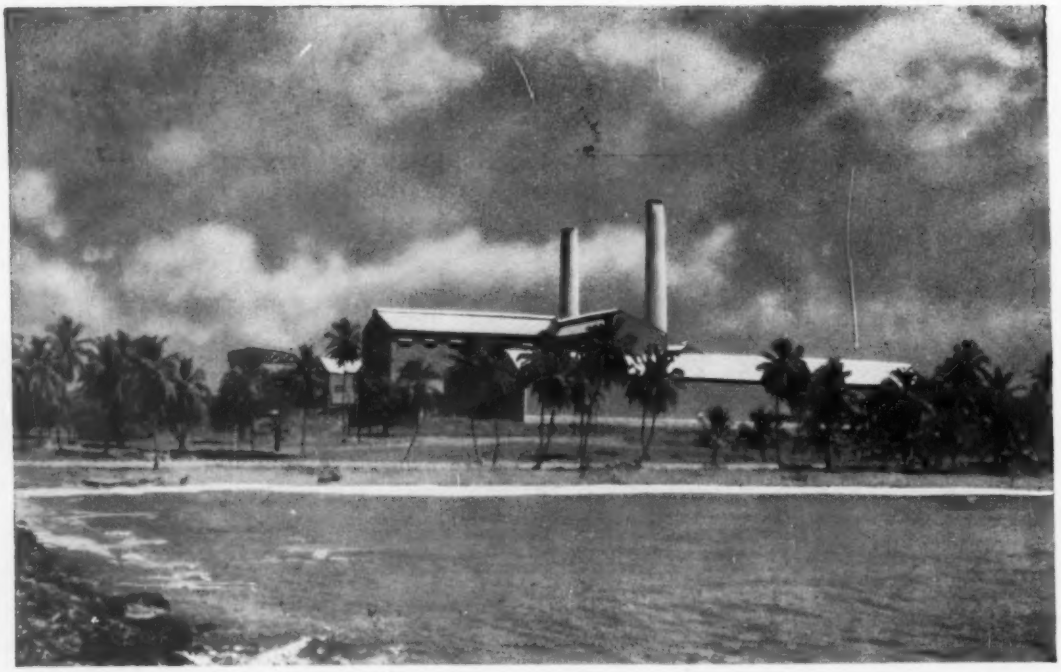
FROM SUGAR CANE

With 'Mirrlees'



Central Rio Haina in the Dominican Republic selected Mirrlees equipment to increase capacity from 6,500 to 13,000 tons cane per day. Last crop they ground 1,205,016 tons. They produce raw sugar.

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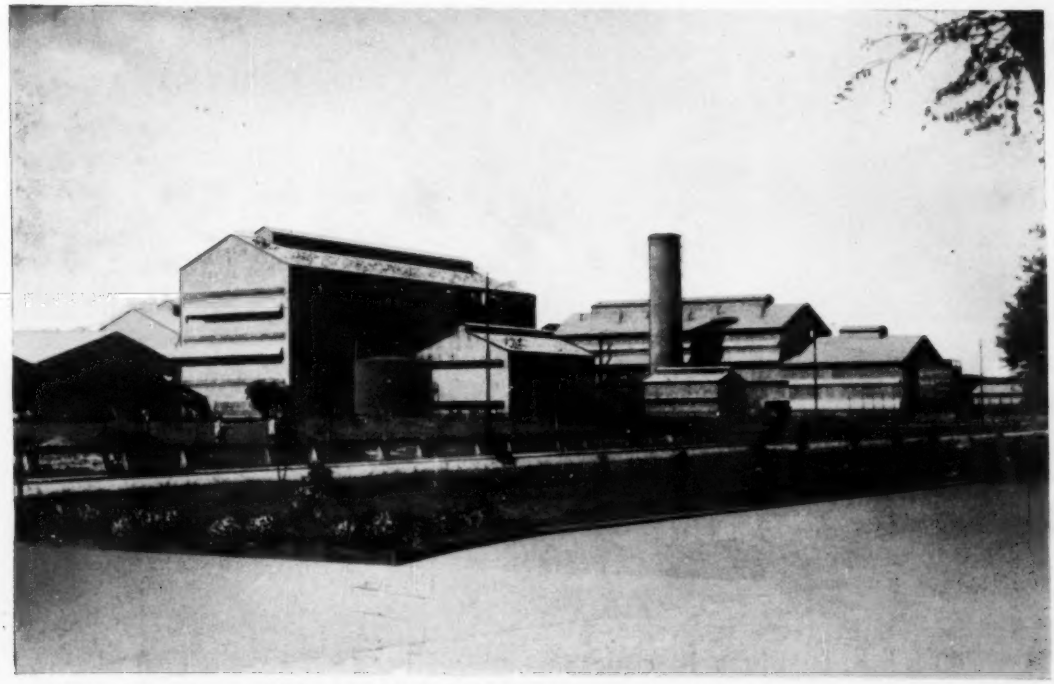

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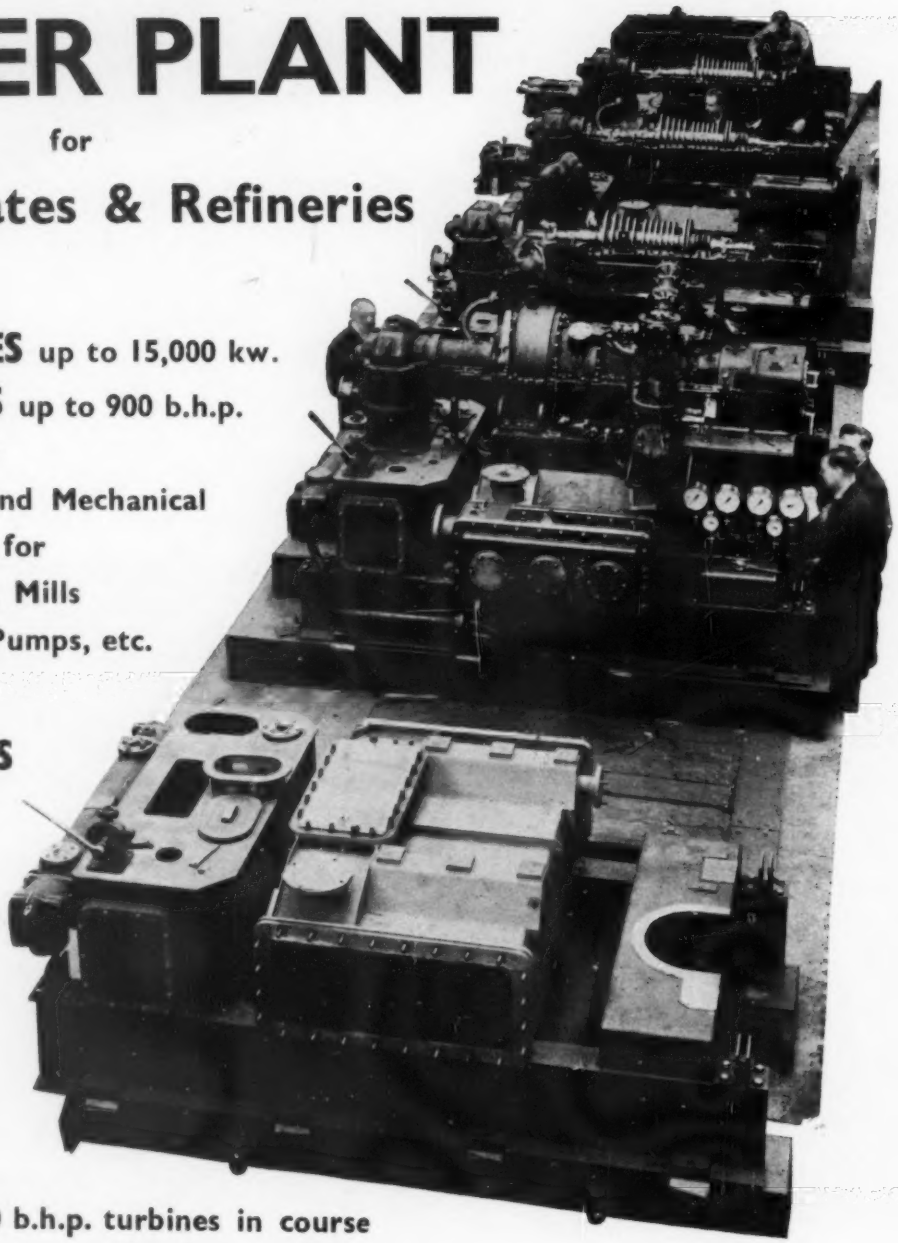

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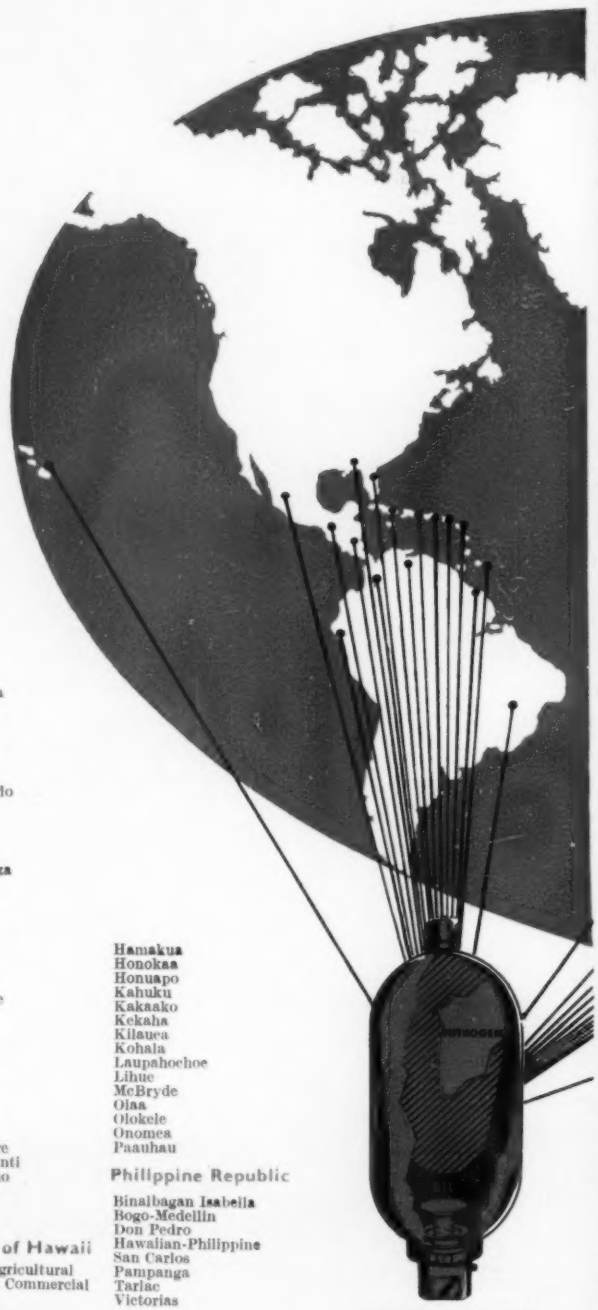

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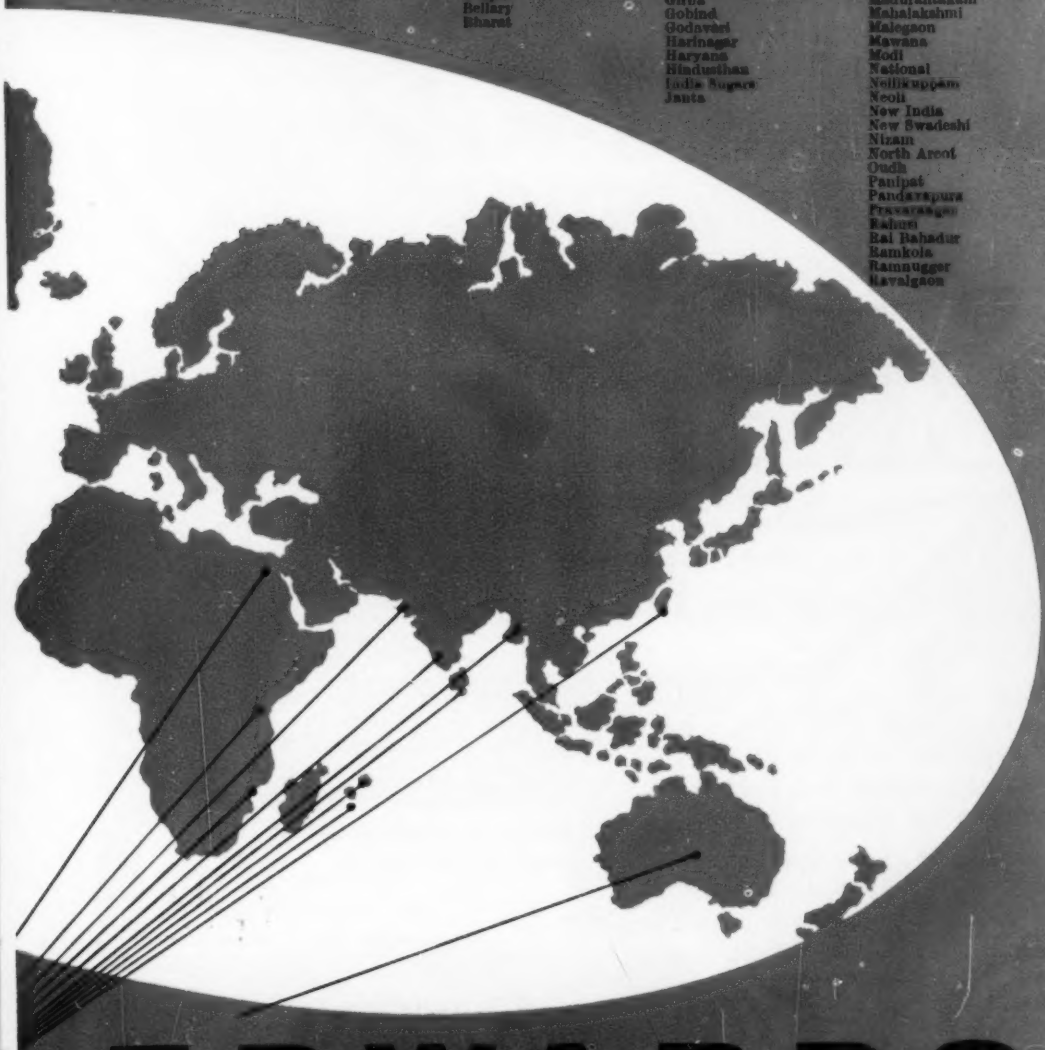

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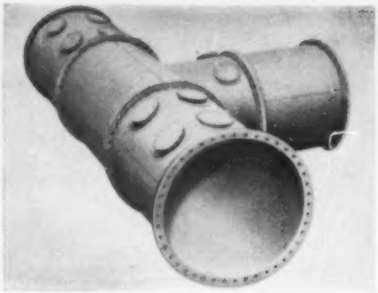
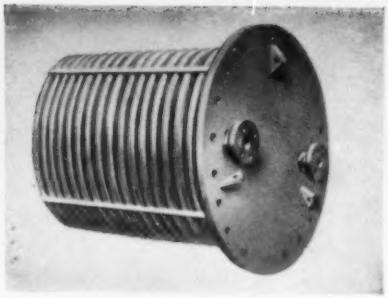
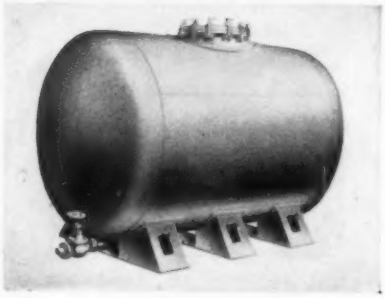
U.S. PATENT 2,801,589; British Patent 878,853; French Patent 1,089,859; Cuban Patent 15,078; Mexican Patent 52,402; Patents Pending Other Countries







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ARE INCREASING THEIR PRODUCTION BY USING

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IN THE DRIVES TO CANE FEEDER CONVEYORS

Automatic regulation of feed ensures that cane knives are always working at peak efficiency thus achieving maximum throughput

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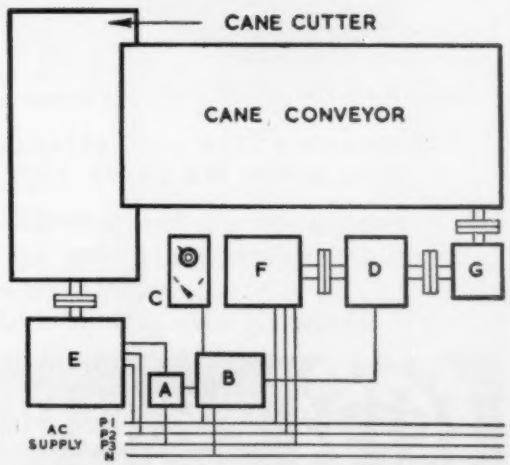

KEY TO DIAGRAM

- **A** Current transformer
- **B** Electronic excitation unit
- **C** Manual control of conveyor speed
- **D** HEENAN-DYNAMATIC COUPLING in conveyor drive
- **E** Cutter motor
- **F** Conveyor motor
- **G** Gearbox

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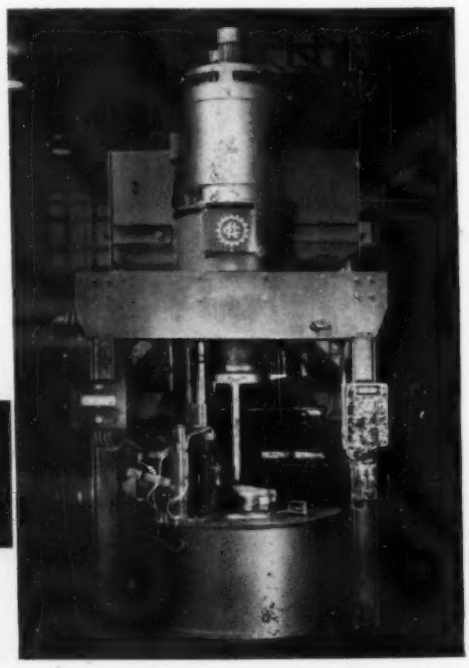
• • • **FIVES-LILLE** *and* **CAIL**
(1861) (1812)

the two oldest French sugar machinery manufacturers have united their powerful designing, research and production facilities.

FIVES LILLE-CAIL
is putting four works employing 10.000 people
at the service of the sugar industry

One of its achievements :
the FULLY AUTOMATIC CENTRIFUGAL
- *drive by Ward-Leonard system*
- *electronic control*
- *record production with massecuites of all grades*



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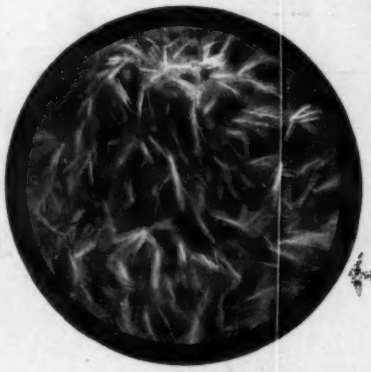
UNIFORM PREPARATION OF SUGAR CANE ASSURED THE WORLD OVER

The GRUENDLER Cane Shredding Process prepares any variety of cane so that maximum mill efficiency is achieved

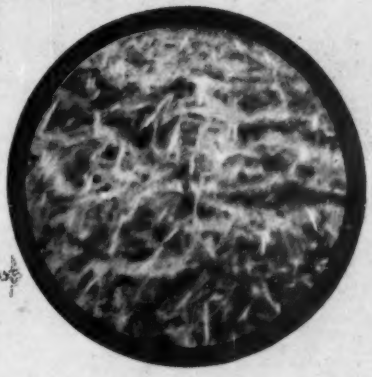
THE GRUENDLER-SHREDDED CANE SHOWN IN PHOTOGRAPHS BELOW IS FROM TWO HEMISPHERES: ONE IS FROM THE ORIENT, THE OTHER FROM THE WESTERN HEMISPHERE WHERE VERY HIGH FIBER AND HIGH TRASH CONTENT PREDOMINATE



With the Gruendler Process, mills have only one function to perform . . . to squeeze the juice out of the cane *without the added task of breaking the very hard joints and rind before extracting the juice.*

NOTE THE UNIFORMITY

Which is the Cane from The Western Hemisphere and which is from The Orient?*



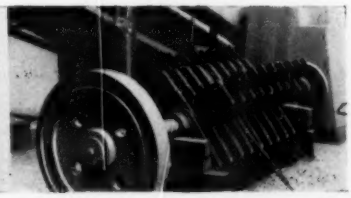


Photo shows one set of modern cane knives made unnecessary by the installation of the Gruendler Cane Shredding Process.

FUNDAMENTAL ADVANTAGES of the GRUENDLER PROCESS

- **No additional mill stands required**
- **No high hydraulic pressures required**
- **Lower maceration (all juice-bearing cells ruptured)**
- **Higher sucrose extraction (percentage sucrose in cane)**
- **Mill maintenance greatly reduced**

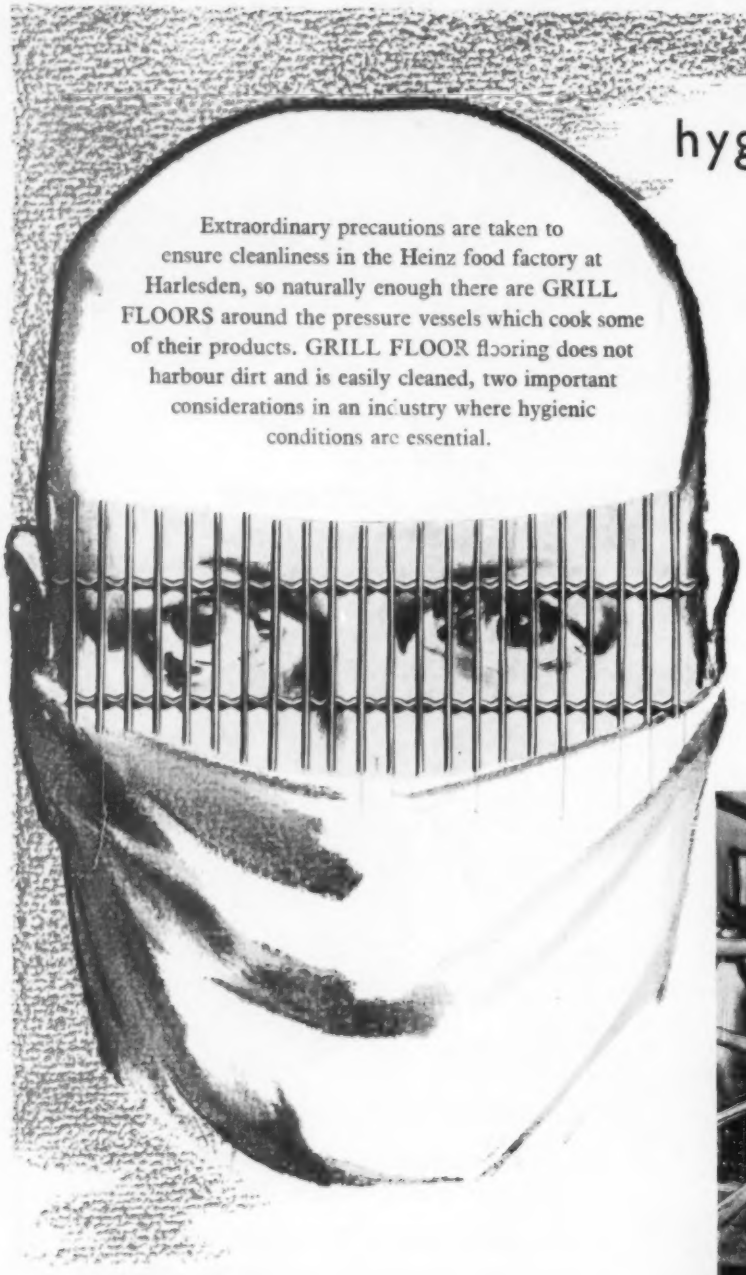
If you would like to know more about the application of the Gruendler Cane Shredding Process, write:

Gruendler

CRUSHER AND PULVERIZER COMPANY

2915 N. Market • St. Louis 6, Mo. • U.S.A.

*Cane on the left is from the Orient, cane on the right from Western Hemisphere.



hygiene at HEINZ

Extraordinary precautions are taken to ensure cleanliness in the Heinz food factory at Harlesden, so naturally enough there are GRILL FLOORS around the pressure vessels which cook some of their products. GRILL FLOOR flooring does not harbour dirt and is easily cleaned, two important considerations in an industry where hygienic conditions are essential.

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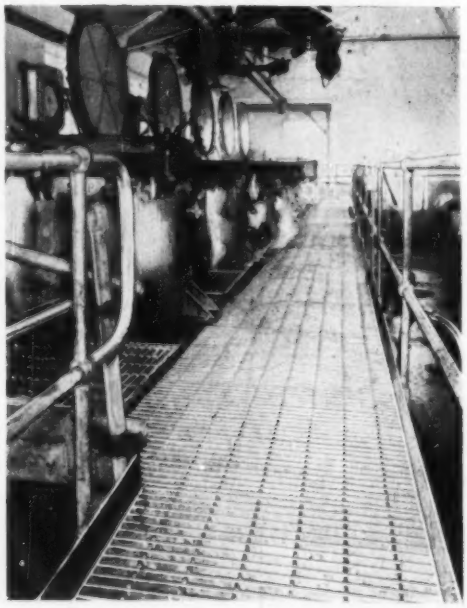

CRILL FLOOR flooring surrounding pressure vessels at Heinz, Harlesden factory, London.

CRILL walkways

GRILL FLOORS LTD LONDON W.10

TELEPHONE: LADBROKE 3066-7 (2 LINES) *TELEGRAMS: ETYLADEC WESPHONE LONDON*

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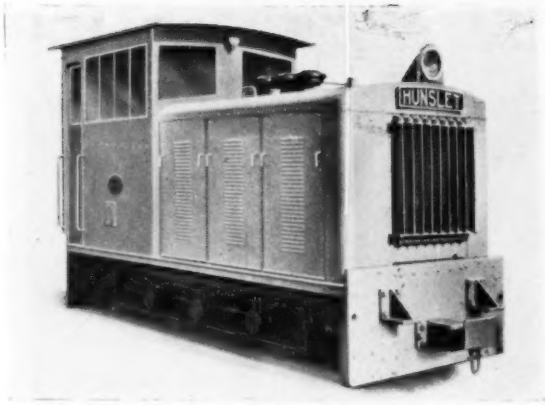
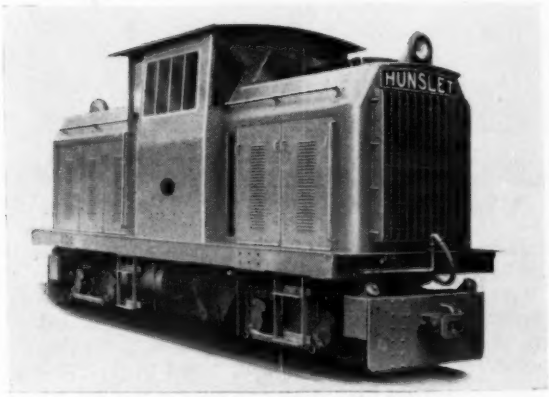
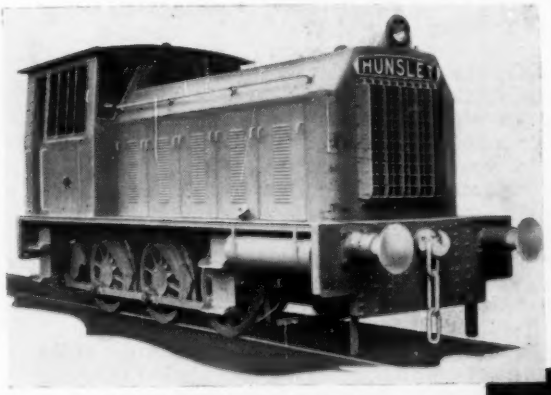


101 h.p. 0–6–0 type Diesel Locomotive



230 h.p. "Articulated" Diesel Locomotive



204 h.p. 0–6–0 type Diesel Locomotive

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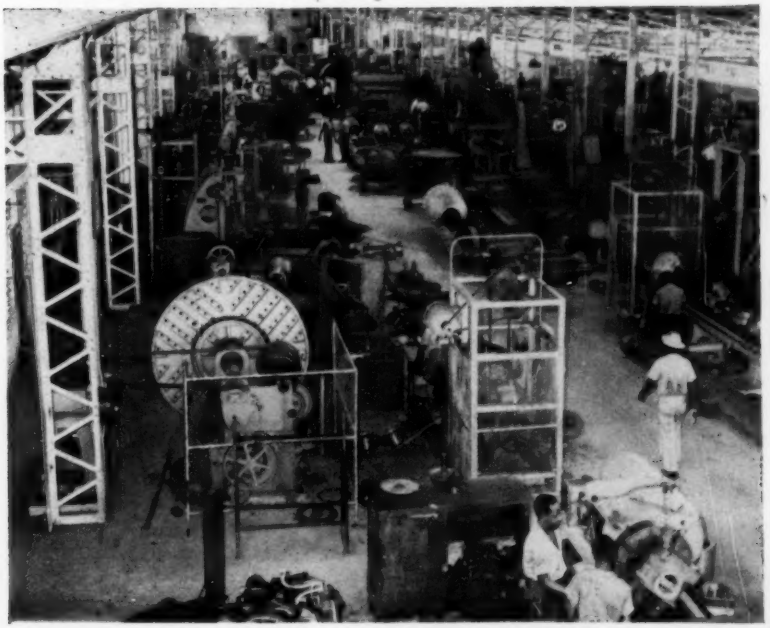

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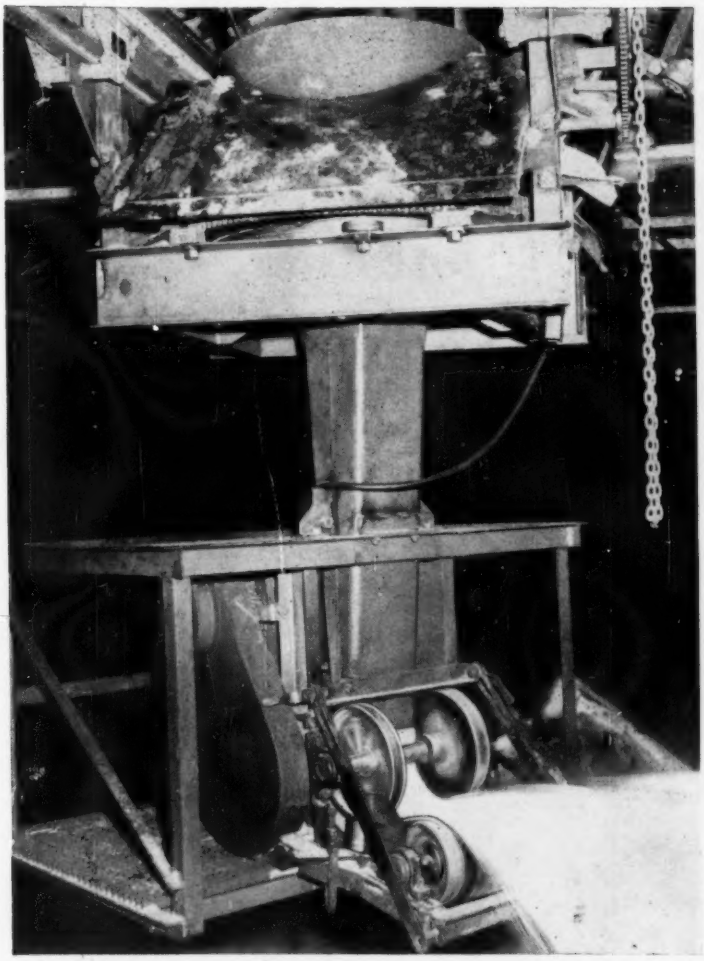
How LINK-BELT Jetslingers and conveyors coordinate

warehousing of 30,000 tons of raw sugar



JETSLINGER piles sugar throughout the vast storage area of this warehouse. Trolley-mounted, under Link-Belt transverse shuttle conveyor, this unit can rotate 360°. It is one of two Jetslingers cutting handling costs at this mill.

70 tons per hour move into storage at Fajardo Sugar Co.

This highly efficient handling system conveys raw sugar from centrifugals to scale hoppers for accurate weighing. It is then conveyed to storage by belt conveyors and to two Link-Belt Jetslingers. Portable belt conveyors are used for loading sugar into trucks. Link-Belt bucket elevators and screw conveyors are also a key part of this Puerto Rican installation.

Link-Belt offers a complete line of conveying and power transmission machinery for the sugar industry—designed to assure low per-ton handling costs. If desired, Link-Belt will design, equip and supervise erection of an entire sugar handling system . . . tailored exactly to your space and capacity requirements. For complete details, contact your Link-Belt representative. Or write direct.

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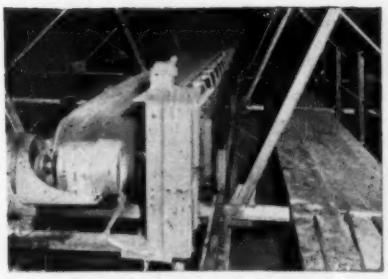
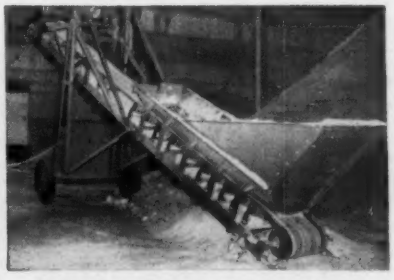
3 TYPES OF LINK-BELT CONVEYORS EMPLOYED AT CENTRAL FAJARDO MILL

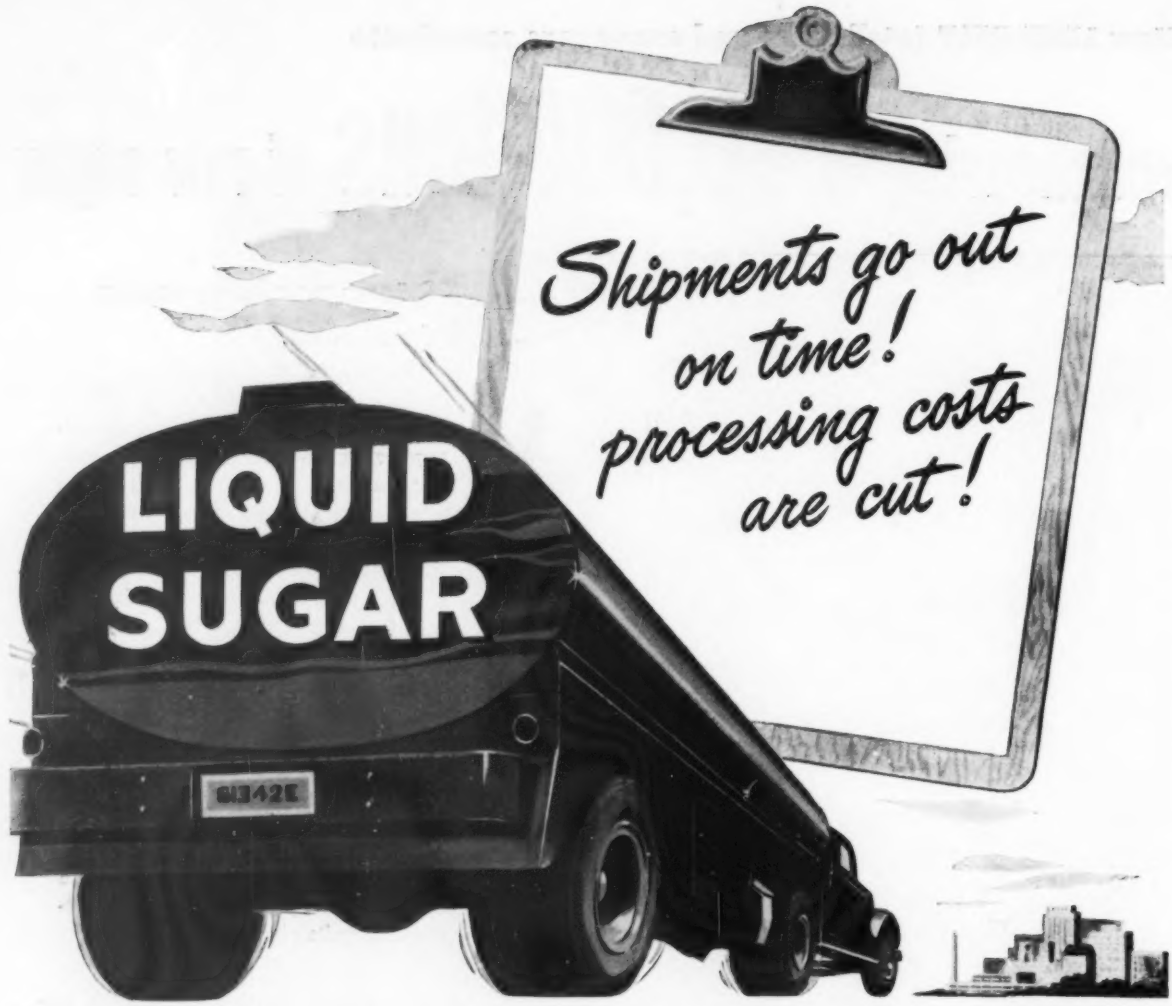


REVERSIBLE SHUTTLE CONVEYOR operates in warehouse discharging sugar from either end to Link-Belt Jetslinger.

INCLINED BELT CONVEYORS handle sugar from scale hoppers and onto transfer belt conveyor for delivery to storage.



PORTABLE BELT CONVEYORS used for reclaiming sugar from storage pile for delivery into trucks.



YOU SAVE both time and money when you clarify sugar liquors with Celite* diatomite filter aids. Save time because Celite filtration lets you combine P_2O_5 lime defecation, decolorization and clarification *all* in one operation (and assures you of outstanding color removal and brilliant clarity, too). Save money because you use your existing mixing tanks and filters and reduce decolorizing vegetable carbon consumption. In addition, in bone char refineries, char filter loads are also reduced when Celite filtration is used.

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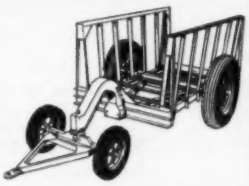
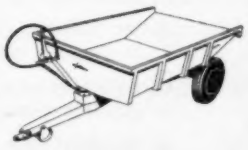


For constructional jobs, road making, etc., this 3-ton hydraulic tipping 'Dumper' trailer is a winner; very strongly made, it will give years of service under the most arduous conditions.



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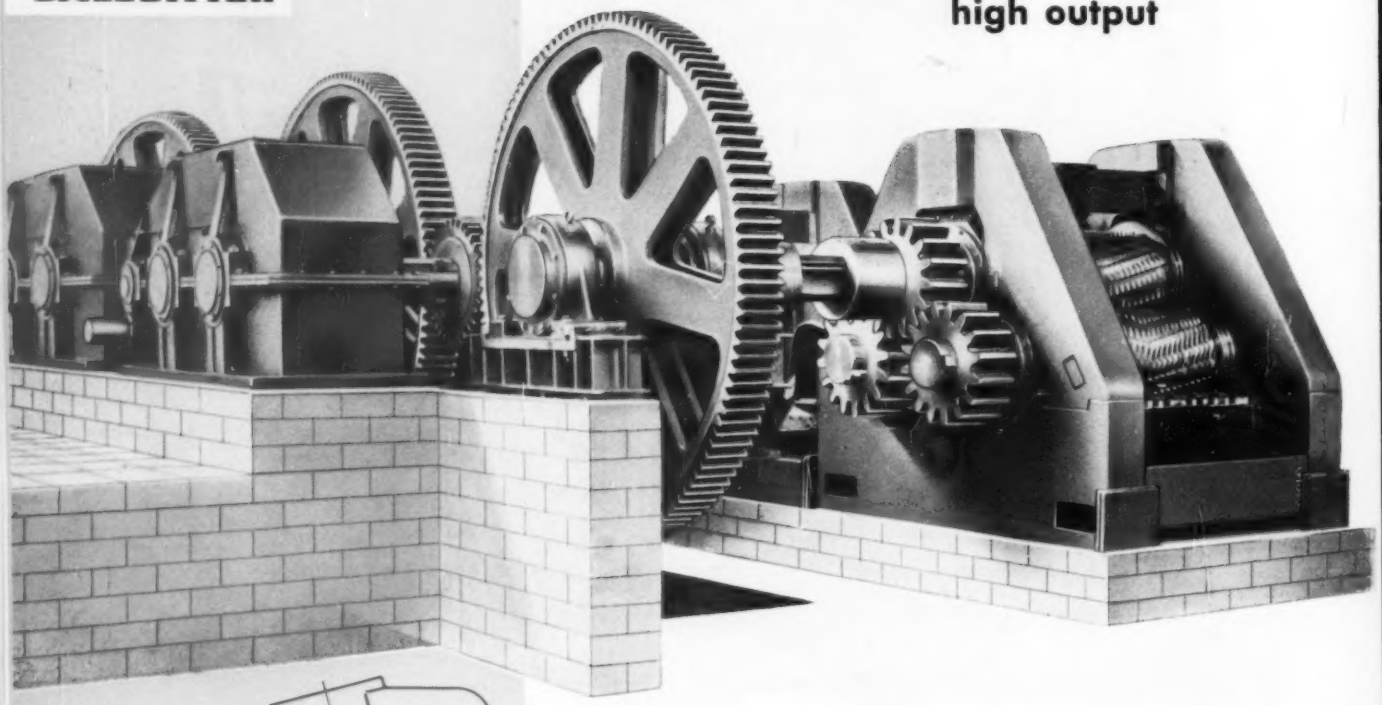

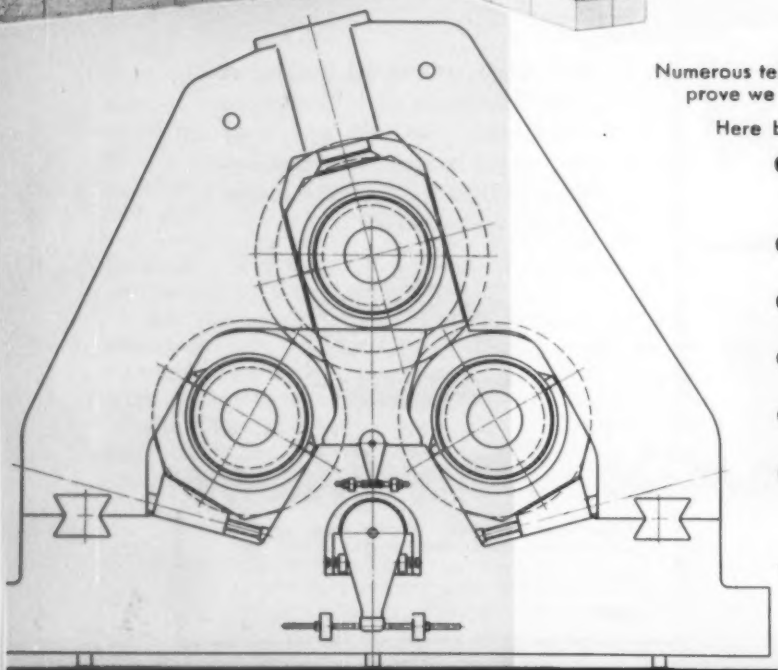

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This machine is fitted with a conveyor 10 or 12 ft. overall and a Special Clutch Drive which allows the conveyor to be run independently of the sewing head.

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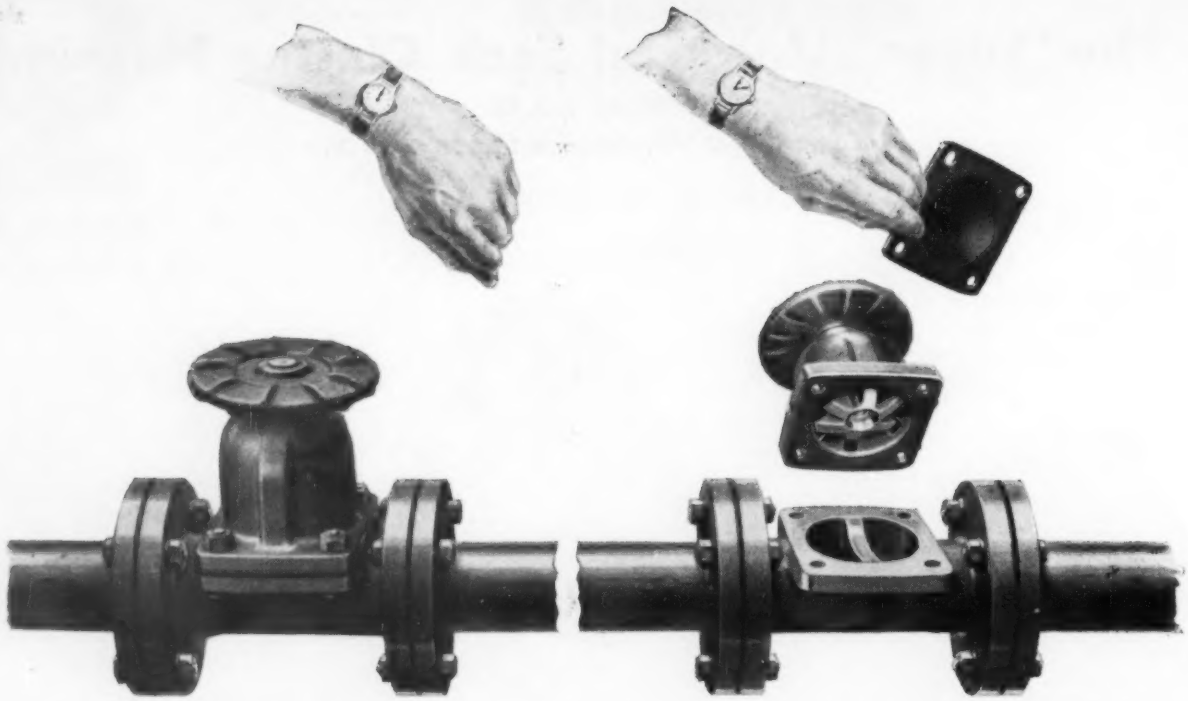

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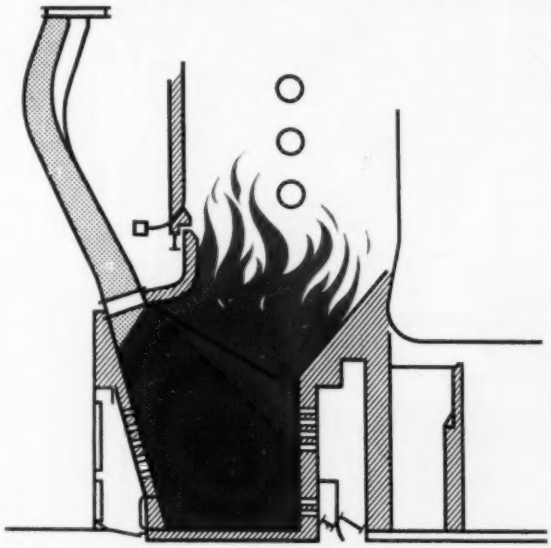
THOMPSON - EISNER FURNACES
AT THE
INGENIO CONCEPCION SUGAR MILL



- Simplicity.
- Economy of operation.
- Ample fuel reserve.
- Rapid response
- Ash problem minimised.

Thompson-Eisner furnaces are operating most successfully at Rio Turbio, Venezuela, with boilers of 108,000 lb/hr evaporation. However, the new installation at the Ingenio Concepcion sugar mill in Argentina is even larger. To date, this is the largest unit fitted with Thompson-Eisner furnaces. As a result of its special advantages the Thompson-Eisner furnace was chosen in preference to the other types of bagasse furnace. In particular it has an ample fuel reserve to allow for continued operation up to twenty minutes should there be any failure in the supply of fuel. Simplicity of design and the absence of mechanical throwers and firebars keep maintenance at a minimum.

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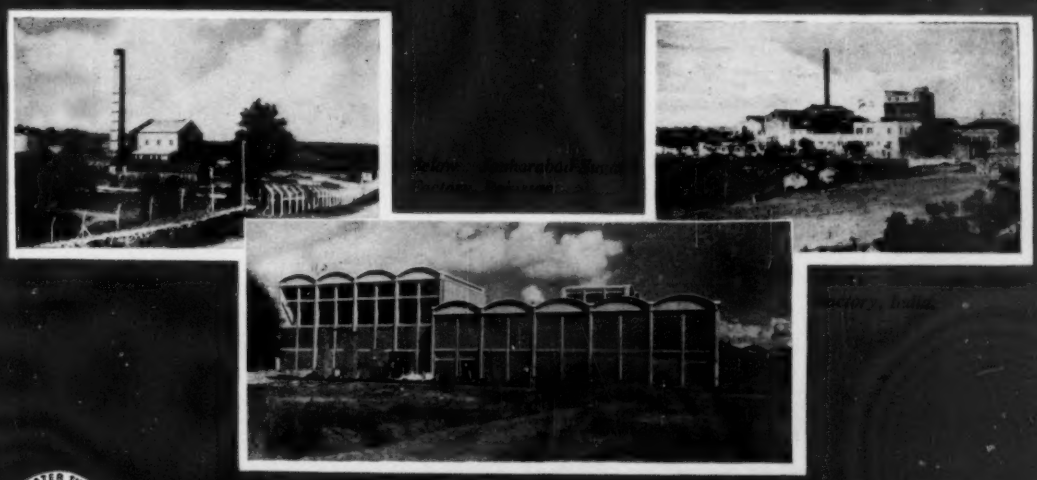
These furnaces are being built under licence from John Thompson by Sociedad Caren.

Among many users of Thompson-Eisner Furnaces



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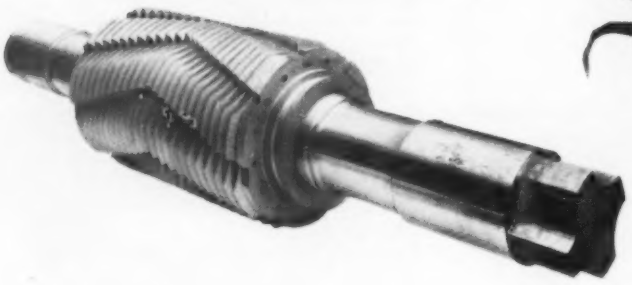
WTSU/3

Bauduin

rough surface of the shell enlarged



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- special material evolved by years of research.
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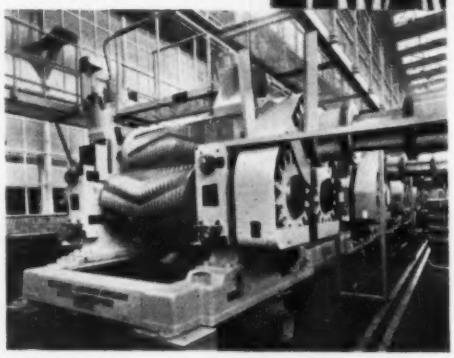

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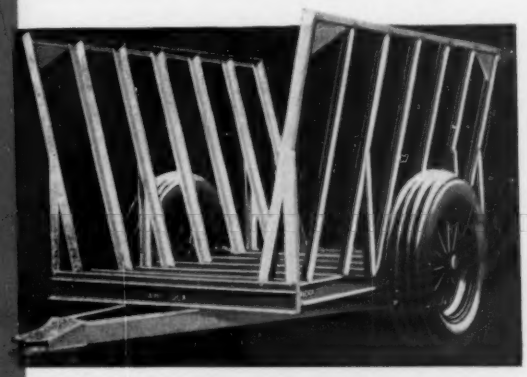

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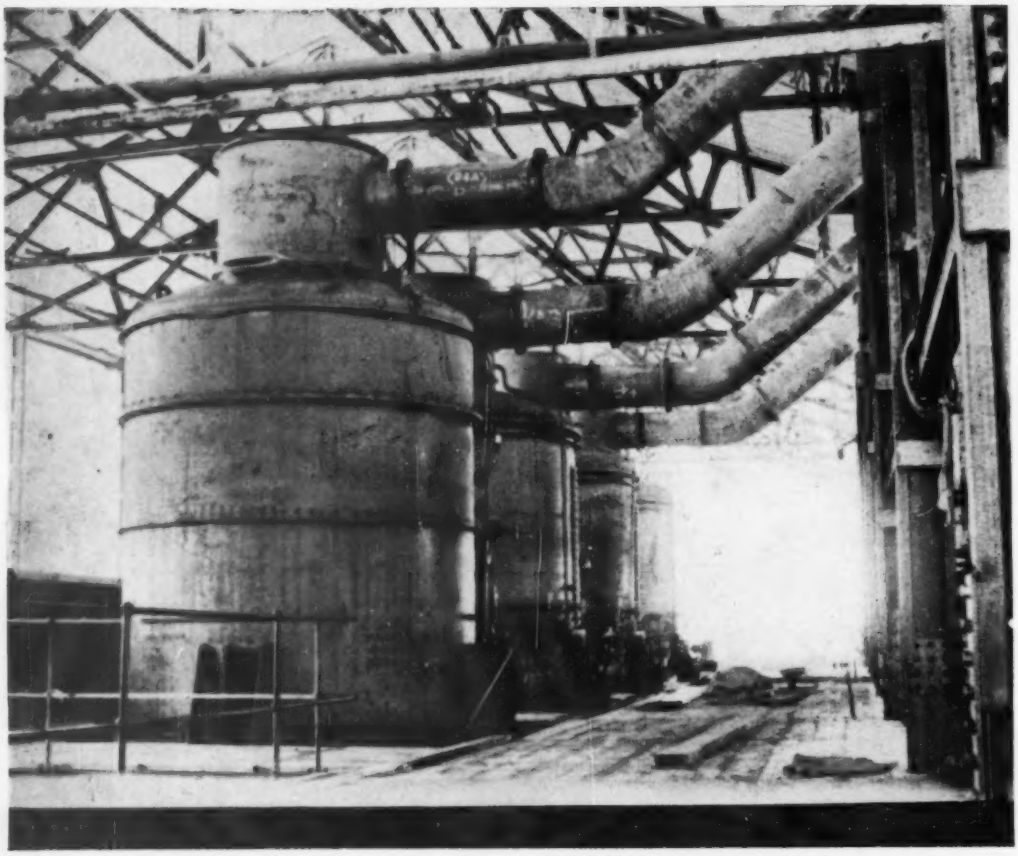

*vacuum pans by *Craig*

* *manufacturers of machinery for Complete Sugar Factories.*

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Published by :
The International Sugar Journal Ltd.
7 & 8, Idol Lane, London, E.C.3.
Telephone : MANsion House 6822.
Cable : Sugaphilos, London.

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Annual Subscription: 32s 0d or $5.00 post free
Single Copies: 2s 6d or 45 cents post free

VOL. 61 *March 1959* No. 723

PAGE

Notes and Comments 65
International Sugar Council. Increased Surcharge on Sugar. Tate & Lyle Ltd., 1958 Report. Indian Sugar Production, 1957/8.

* * *

Agricultural Articles :

The Sugar Cane in Queensland 67
58th Annual Report, Bureau of Sugar Experiment Stations, 1958.

The Sugar Cane in the United States 69
Meeting of the Americal Society of Sugar Cane Technologists, Louisiana, 1958.

Agricultural Abstracts 70–71

* * *

General Articles :

Mill Torque as a Function of Roll Loading .. 72
Part II.—Development of Dimensional Analysis
By C. R. Murry.

The Factors Affecting Stability and Flocculation in Cane Juice 77
By M. C. Bennett.

Comparative Steam Consumption in Remelting Sugar with Water and Clear Juice 80
By S. P. Sanyal.

* * *

Sugar-House Practice 82
New Mill for Peru. Effect of Temperature on the Last Phase of Low Grade Massecuite Maturing. The Sugar Industries of Mauritius, Réunion and South Africa *etc.*

Beet Factory Notes 87
Campaign Observations on the BMA Tower. Experiments on Beet Lifters. Automatic Control of Second Saturation in Sugar Production using a pH Meter and a Flame Photometer *etc.*

New Books and Bulletins 89
Basic Calculations for the Cane Sugar Factory. The Sugar Economies of the South American Continent. Plantation Crops.

Laboratory Methods and Chemical Reports 90
Determination of Chlorides in Sugar Solutions. Viscosity of Refinery Molasses. Hydrolysis of Carbohydrates in the Presence of Hydrochloric Acid or Acidic Ion-Exchange Resins *etc.*

Patents 92
Beet Harvesters. Weighing Machines. Dissolving Sugar. Syrup-Separating Device for Sugar Centrifugals. Centrifugals. Beet Harvesters *etc.*

Trade Notices 94
New Plug-in Relays. Shaffer Poidometers.

United Kingdom Sugar Imports and Exports 95

Stock Exchange Quotations 96

Brevities 95–96

Index to Advertisers xliv

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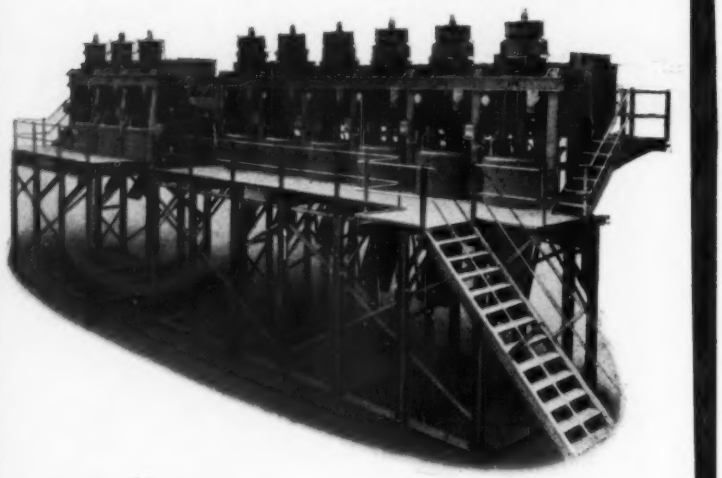

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THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXI MARCH, 1959 No. 723

NOTES AND COMMENTS

International Sugar Council.

The first session of the International Sugar Council under the 1958 International Sugar Agreement was held in London on 28th and 29th January 1959. In accordance with a resolution adopted by the United Nations Sugar Conference 1958, the Session was called by D. J. MUIR, Australia, Agent-General for Queensland in London, who presided at the opening of the Session.

It was reported that thirty-four countries had signed the 1958 International Sugar Agreement. Delegations of thirty-two countries members of the Agreement attended the Session.

The Council unanimously elected D. A. BRUCE MARSHALL, Canada, Agricultural Counsellor, Office of the High Commissioner for Canada, London, as Chairman for 1959. Mr. MARSHALL took over the Chairmanship of the Session.

His Excellency Dr. LEON MA. GUERRERO, Ambassador of the Philippines, was unanimously elected Vice-Chairman of the Council for that year.

The Council also appointed committees for 1959 as follows:

Executive Committee—Chairman, the Executive Director of the Council, E. ROLL, C.B., C.M.G.

Statistical Committee—Chairman, Dr. H. E. PRIESTER, delegate of the Dominican Republic.

Finance Committee—Chairman, Mr. E. WINTERSGILL of the delegation of the United Kingdom.

Credentials Committee—Chairman, Dr. BAKKER, delegate of the Kingdom of the Netherlands.

The Council considered and approved an application for accession to the Agreement by El Salvador, under the provisions of Article 41 (4). El Salvador is acceding as an exporting country with maximum permissible exports to the free market of up to 5,000 metric tons, raw value, and will be holding ten of the total votes of exporting countries under the Agreement.

The Council adopted an estimate of the minimum net requirements of the free market for 1959 amounting to 5,405,000 metric tons, raw value.

The Council decided that provisional export quotas to the free market should be the basic export tonnages established under the Agreement. In arriving at this decision, the Council had regard to present uncertainties in the sugar supply position ; to the fact that this allocation of quotas is provisional only and must be followed by a final determination at the next session of the Council which will open on 19th March 1959 ; and that the Agreement contains an automatic mechanism and provides for a prompt meeting of the Council if the market situation so requires.

The Council deferred until its next session the consideration of the establishment under Article 18 (6) of a Special Reserve to meet cases of special hardship.

In accordance with Article 22, the Council appointed a Committee to consider the conclusion of multilateral contracts for options to purchase or to sell pre-determined quantities of sugar when the price rises above or falls below the higher or lower prices referred to in Article 21.

The Council set up a Committee under Article 26 with special reference "ways and means of securing appropriate expansion in the consumption of sugar".

* * *

Increased Surcharge on Sugar.

The surcharge on sugar, levied by the Sugar Board, was increased on and from 22nd January, 1959, by approximately ½d per lb of refined sugar. Surcharge repayments, payable by the Sugar Board on goods entitled to drawback of sugar duty (e.g. on export), will be correspondingly increased provided that surcharge has been paid on the goods at the new rate. The new rates of surcharge and of surcharge repayments are shown below.

The increase in the surcharge is necessary because the Board are required by Section 4 of the Sugar Act, 1956, to balance their revenue account "taking one year with another". The Board's account showed an under-recovery of £7·6 million at 30th June, 1958, and since then the guaranteed price paid by the Board for Commonwealth sugar has increased and the world price has recently fallen.

The previous surcharge which was imposed on 20th February, 1958 was equivalent to about 1¼d per lb on refined sugar. The new surcharge is equivalent to about 1¾d per lb on the same basis. Accordingly from 22nd January the first-hand (ex-refinery) selling price of refined sugar in the home trade became, as a result of the change, about ½d per lb higher than it would otherwise have been. Retail prices are determined by competition among traders but in general follow significant movements of the first-hand price.

SURCHARGE RATES FOR SUGAR

Polarisation	Rate of surcharge per cwt of sugar s	d
Exceeding 99°	16	4·0
98° but not exceeding 99°	15	4·8
97° " " " 98°	15	0·3
96° " " " 97°	14	7·6
95° " " " 96°	14	2·9
94° " " " 95°	13	10·2
93° " " " 94°	13	5·5
92° " " " 93°	13	0·8
91° " " " 92°	12	8·0
90° " " " 91°	12	3·3
89° " " " 90°	11	10·6
88° " " " 89°	11	5·9
87° " " " 88°	11	2·0
86° " " " 87°	10	10·1
85° " " " 86°	10	6·6
84° " " " 85°	10	3·0
83° " " " 84°	9	11·5
82° " " " 83°	9	8·0
81° " " " 82°	9	4·8
80° " " " 81°	9	1·7
79° " " " 80°	8	10·6
78° " " " 79°	8	7·4
77° " " " 78°	8	4·3
76° " " " 77°	8	1·2
Not exceeding 76°	7	10·0

SURCHARGE RATES FOR MOLASSES

Sweetening matter content	Rate of surcharge per cwt s	d
70% or more	10	9½
Less than 70% and more than 50%	7	10
Not more than 50%	3	11

SURCHARGE REPAYMENT RATES FOR MOLASSES PRODUCED IN THE UNITED KINGDOM FROM DUTY-PAID MATERIALS

Sweetening matter content of molasses	Rate of surcharge repayment per cwt s	d
More than 80%	12	3
" " 70% but not more than 80%	10	9½
" " 60% " " 70%	7	10
" " 50% " " 60%	5	10½
Not more than 50% and the molasses not being less in weight than 14 lb per gallon	3	11

* * *

Tate & Lyle Ltd., 1958 Report.

Home trade sales totalled 1,489,045 tons for the year, only 1015 different from the 1957 figure and 669 tons from the 1956 figure. Export sales fell from 702,671 tons in 1957 to 588,192 tons in 1958 which represented 28% of the total. The margin between the price of raw sugar and that of refined sugar for home trade consumption continued to remain below the limit guaranteed to the Chancellor of the Exchequer. In October 1957, Tate & Lyle Ltd. acquired from the United Molasses Co. Ltd. the whole of the issued capital of Merton Grove Co. Ltd., syrup and treacle manufacturers of Liverpool. The opportunity was also taken of acquiring, at a favourable price, a large block of shares in Canada and Dominion Sugar Co. Ltd. which came on the market.

New offices at Thames Refinery were completed, replacing accommodation over 50 years old. Rhodesia Sugar Refinery Ltd., in which Tate & Lyle has a substantial holding, is building a new refinery at Ndola in the Copper Belt. Raw sugar will be supplied from the raw sugar estate which has been developed some 250 miles to the south, near the new Kariba dam.

One of the most recent additions is the new packing station at Wandsworth. To reduce transport costs, refined sugar is carried in bulk tankers to this and the sister plant at Keynsham, near Bristol. The sugar is packed in 2 lb paper bags for distribution throughout the area.

A feature of the reports is the number of large photographs in colour, illustrating various aspects of the Company's refinery operations, the head office entrance, new construction at Ndola and m.v. "Crystal Bell", the second of the bulk sugar ships built by Sugar Line Ltd. to carry raw sugar in bulk from suppliers mainly in the West Indies.

* * *

Indian Sugar Production, 1957/8.[1]

The 1957/58 season ended with a production of 1,975,912 tons, which compares with 2,016,179 tons in the previous crop and with the second Plan target of 2,250,000 tons. Although the drop in production is only 50,000 tons the fact that the upward trend has been arrested is disquieting, and the fact that additional capacity worked during the year was responsible for a production of 140,000 tons increases the drop in production to a substantial level. The most important factor affecting production has been the diversion of cane to khandsari units which has, in the case of factories in the West U.P. (the largest sugar-producing region), accounted for a loss of about 20% in the estimated cane supply. As a result sugar production has fallen by 13,100 tons while khandsari production has risen by 10–20,000 tons. Another important factor has been lower cane yield which has reduced sugar production in Bihar from 31,200 to 27,500 tons. The position of factories in North India has been made difficult by the introduction of Government control of ex-factory prices which have been set at figures which proved uneconomical for many factories.

* * *

Professor J. Dedek.—Professor J. DEDEK, Dr.-Ing., Dr. agr. h.c., has been nominated by the Rector of the Berlin Technical University as permanent guest professor to lecture on the chemical fundamentals of sugar technology. Professor DEDEK will give regular courses of lectures at the Institut für Zuckerindustrie on specific problems of juice purification.

[1] *Indian Sugar*, 1958, **8**, 483–484, 527.

THE SUGAR CANE IN QUEENSLAND

58th ANNUAL REPORT, BUREAU OF SUGAR EXPERIMENT STATIONS, 1958.

THE Report of the Director gives a summary of the Sectional reports, placing these in perspective, but adds some facts of general interest. The unusual climatic contrasts of the season under review (July 1957—June 1958) are noted, including the disastrous drought in S. Queensland early, and the very serious flooding in the Mackay and Lower Burdekin Districts late in the period covered. It is also of interest to note the cost of the research and other services of the Bureau which was covered by a 4½d levy per ton crushed and amounted to 0·27% of the value of the raw sugar produced. This section of the Report is accompanied by tables showing acreage and yields and the mill peaks (tons 94 n.t. sugar) for the several mills in selected years from 1929, during which period production has nearly doubled. Since 1948 the amount of molasses used as fertilizer has doubled and a gradual diminution taken place in the amount used for stock feed.

Division of Soils and Agronomy

The ploughing in of a green crop is a standard practice. To test whether sufficient nitrogen was thereby supplied for the more vigorous varieties now in cultivation, a series of trials was undertaken with added sulphate of ammonia at increments of 1 cwt—from 1 to 5 cwt per acre. The results fall into two groups : those experiments in which a considerable increase in yield of cane occurred and those in which the increase was slight. In the former, a steady decrease in c.c.s. occurred, from 16·9 to 15·6, with a cash return rising from £197 to £208 for the 1-cwt dressing and then falling regularly to £203 for the 5-cwt dressing. In the latter, the c.c.s. fell slightly for the two highest dressings.

Experiments in progress cover NPK trials of different soils, with emphasis on the K element, poor growth and deterioration, and soil moisture. In the last, comparisons between plots irrigated (a) at wilting point and (b) at ⅓ available moisture, receiving respectively 3 and 5 irrigations during the dry season, showed a definite increased vigour in the latter which continued apparent well into the wet season. Comparative measurements with plaster of paris blocks and standard measurements showed adequate accuracy of the former to justify their use. Measurements to the depth of nearly 6 ft were taken. As a check for poor growth, in so far as it is due to the root knot nematode (Meloidogyne sp), injections of various nematicides, including "Nemagon", are under trial. No very clear results were obtained for varietal differences in deterioration of freshly burned cane up to 12 days after cutting, though Q 44 and POJ 2878 appeared more resistant than others.

For varietal selection, a 3-point stab at ¼, ½ and ¾ points of the stem gave an accuracy of 93% of the c.c.s. values as against an 84% accuracy for a single point stab at ⅔ position up the stalk. This is sufficient accuracy to justify adoption of the former method.

Several observations are given to test the effect of hot water treatment on germination. Both in September and November, top setts proved the most vigorous except when taken from arrowed stalks ; and setts from outer rows also proved superior. The source of plants from which setts are taken, i.e. the quality of the germination, good or bad, of the plants, appears to affect the germination of the setts. The response of plant and ratoon material was similar. Cooling setts after treatment by hosing or dipping in "Aretan" solution for 20 min led to no benefit and, in the case of Trojan, a significant deterioration was measured by the number of germinated shoots.

Droopy top, a deficiency disease, is cured by copper sulphate at 50 lb per acre. Soil conservation and weed control are briefly discussed ; in particular, the giant sensitive plant is being rapidly brought under control by dilute arsenical sprays. No clear results were obtained in correlating the rate of decomposition of 2,4-D and MCPA with any differing characteristics in the 22 soils tested.

Division of Plant Breeding

The considerable reorganization in technique and methods of the past 3 years is beginning to show results in the larger number of promising varieties emerging. The season under report was most unfavourable for arrowing. Germination of the 1957 crosses led to vigorous seedling growth which coincided with the substitution of filter cake for leaf mould as the organic ingredient of the compost used and the method of sterilizing soil in pots, using methyl bromide, is illustrated. Various modifications in the varietal selection and grading technique are noted.

Of canes attaining the "Q" status, two, Q 66 and Q 67, are adapted to cultivation on rich lands as resistant to lodging. Two others, L 622 and M 251, also show promise in this direction. Over 85% of the crop is now derived from Queensland varieties, the balance being some 10% New Guinea, and the remainder United States varieties. Of the whole crop, 26·9% is under Q 50, 25·9% under Pindar and 15% under Trojan. Total figures, however, have little meaning owing to unequal distribution. Thus Q 50 provides 74·8% of the crop in Proserpine and Mackay but only 4·1% North of Townsville while, in Bundaberg and South, CP 29–116 provides 37·9%, though the total figure is only 5·3%.

Divisions of Entomology and Pathology

The rapid recovery of the cane crop in S. Queensland after the drought is attributed in large measure to the

body of healthy cane resulting from freedom from ratoon stunting disease through the hot water treatment. A recrudescence of Fiji disease and of bacterial mottle in certain areas provides a timely warning. Other diseases appear well under control.

Notes are given on the various diseases. Ratoon stunting disease, as the result of varietal trials, shows losses ranging from 7·6 to 18·7%, in the case of Pindar, to 22·3% in the case of SJ 4. Bacterial mottle, now named *Pectobacterium carotovorum* var *atrosepticum*, is confirmed as confined to flooded land and probably exists on wild grasses. Varietal resistance appears to be the best means of controlling Fiji disease, downy mildew, leaf scald and mosaic.

Greyback beetles (*Dermolepida albohirtum*), Frenchi (*Lepidiota frenchi*) and other grubs, are well under control through soil treatment with BHC, but continued vigilance is required through flighting from the natural scrub growth. Control of the Frenchi grub, however, appears to require a larger dressing of BHC than the greyback. Grubs of the beetle at present known as "the Mossman beetle" appear to require an even higher dressing. No insecticide has been found to equal BHC, which also appears to give partial control of the funnel ant (*Aphaenogaster pythia*). Notes are also given on the soldier fly (*Chiromyza rubriceps*), earth pearls (*Margarodidae*) and a number of other insect pests of lesser importance.

Animals, particularly rats and, to a lesser extent, wallabies, pigs and a striped phalanger, and birds, of which the cockatoo in areas bordering forest land is one of the most important, are capable of doing considerable damage.

Regional Experiment Stations

The Northern Station is primarily devoted to crossing and to seedling raising and testing. In randomized trials, 54–6441 yielded as plant cane 5·94 tons sugar/acre (Pindar 4·67) and H 40–1184 6·28 tons (Pindar 5·36 tons) as first ratoons. The variety garden contains 452 varieties.

Seedling raising, from fuzz from the Northern Station, and testing is a major task of the Lower Burdekin Station. Of the 1953 "N" series, N 446, with its high sugar content, alone surpassed Pindar. The floods, while causing considerable damage by sand deposition in the crops and serious erosion of land not under crop, provided a good test of the ability of the newer varieties to resist lodging.

The Central Station also suffered severely from the floods. It, again, is largely devoted to seedling raising and varietal selection. A number of imported varieties released from the quarantine station was also grown. A few fertilizer experiments comparing sulphate of ammonia and urea, in which efficiency was equal on an N content basis, testing long-term effect of phosphate and time/sulphate of ammonia, are briefly noted.

At the Southern Station variety introduction and testing formed a prominent feature and Q 70 was distributed for the first time. Here, too, investigations were conducted into the various pests mentioned above and the control of droopy top by dressings of copper sulphate.

Division of Mill Technology

The mills continue to take advantage of the standardization and repair facilities offered by the Bureau. Largely, the apparatus checked is required to be certified under the Central Sugar Cane Prices Acts, but it is the wish of the Bureau that, in the near future, all equipment used in mill laboratories will bear the Bureau standardization mark.

Investigation into the c.c.s. formula continued with analysis of cane at Pleystowe with the wet disintegrator and by the juice scales. Direct analysis is very effective and the results indicate that the arbitrary 3 and 5 of the c.c.s. formula were very much in error for Pleystowe during 1957. There did not appear to be any relationship between the constants and such factors as cane variety, soil type, etc. The disintegrator has been modified by replacing the 5-inch blades with 7-inch ones ; it is likely that extraction can now be reduced to 30 minutes with safety.

The bulk handling installations opened during the year are mentioned, with the advantages arising from them.

Troubles with steam turbines are discussed ; it is emphasized that attention should be paid to providing pure wet steam and superheated steam where practicable, since it is impure wet steam which seems to cause most trouble. An instrument for detecting impurities in condensate proved satisfactory.

Particle boards, made by the "dry" process, using 6% of urea-formaldehyde as a binder for bagasse, have been made and compare favourably with commercial hardboards. An experimental quantity of 12 tons of bagasse-molasses mixture has been made for animal feeding trials. The utilization of bagasse in paper production and the extraction of cane wax are also considered. Tabulated detailed production and other factory data for the districts and all Queensland for the crops 1951–1957 are discussed.

H.M.-L.

Trend of Cane and Sugar Yields per Hectare for the VMC District 1947-57. ANON. *Exp. Sta. Bull.*, Victorias Milling Co., 1958, **5**, (6), 5.—In the 11 years recorded the trend line for cane has risen from under 44 to 56 tons/ha, and that for sugar from under 6160 to 8960 lb/ha.

* * *

A brief Appraisal of some Insect Pest Problems of Sugar Cane in Negros during the 1956-67 Milling Season. V. L. SAPLALA. *Sugar News* (Philippines), 1958, **34**, 18–20.—The pests considered are white grubs (five species), woolly aphis, pink mealy bug and army worms. The estimated loss is 6560 tons sugar.

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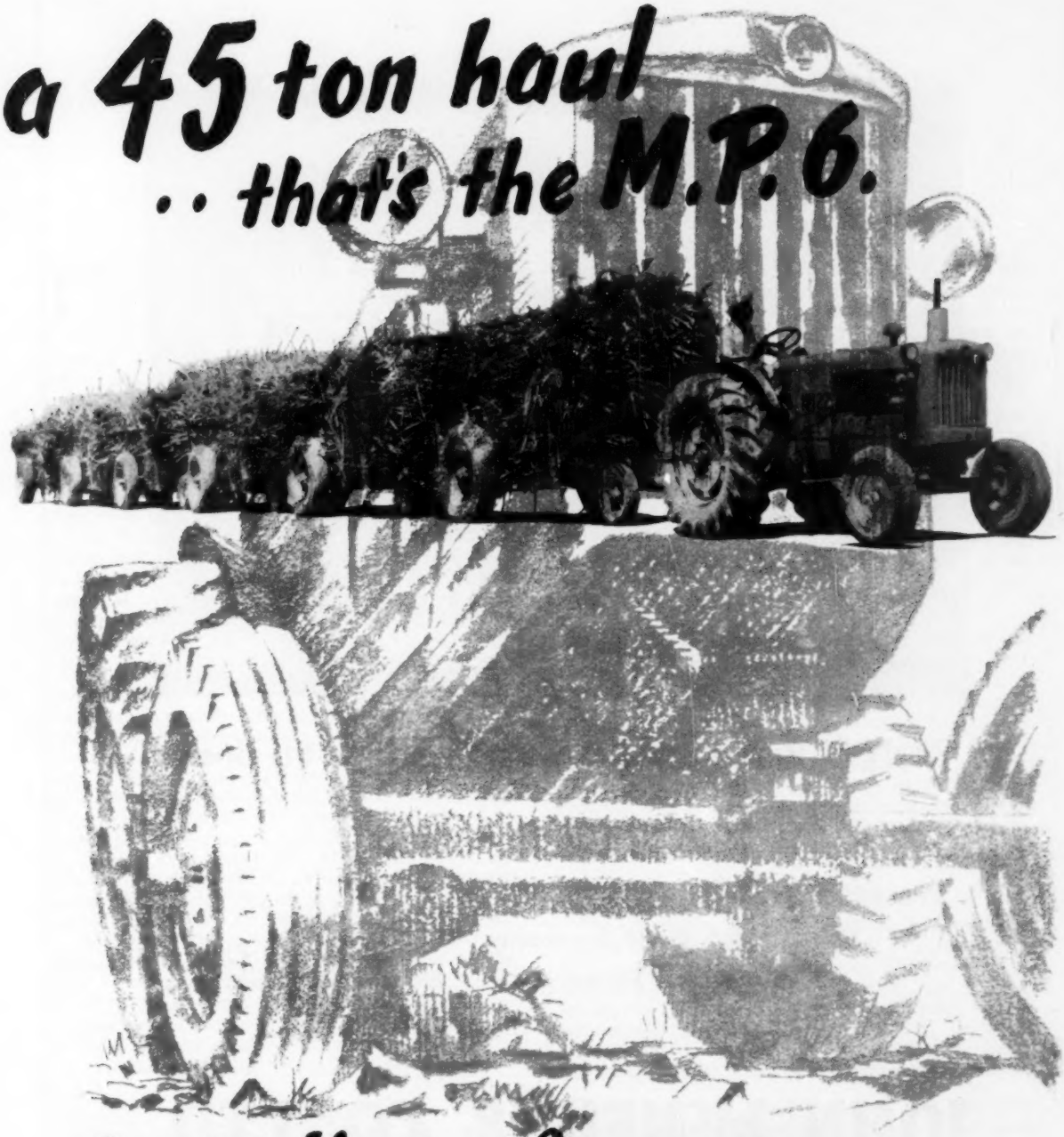

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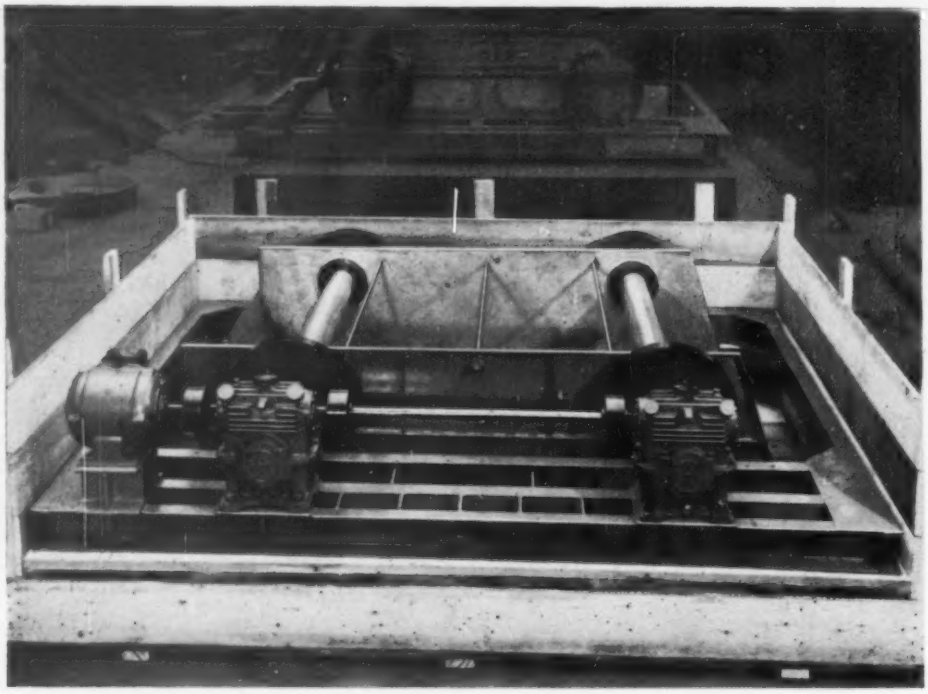

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THE SUGAR CANE IN THE UNITED STATES

MEETING OF THE AMERICAN SOCIETY OF SUGAR CANE TECHNOLOGISTS, LOUISIANA, 1958.

THE maintenance of farm equipment is discussed by R. J. ANDERSON. After drawing attention to the fact that, as the motto has it, a stitch in time saves nine, he advocates on the one hand a regular rotational programme for reconditioning and the development of a co-operative spirit among all who handle any mechanism, from the actual user in the field to the mechanic in the workshop. This can be brought about by instruction of all in a manner which develops pride in good work.

The case of tyre usage is taken as an example. On many plantations tyres are discarded which have 50% or 60% of life left in them ; yet many small farmers extract 80% to 90% of the full life. He compares also the merits of the low pressure tyre for tractors and the water-filled tyre. Without expressing any final preference, his argument falls weightily in favour of the former.

Recent varietal changes have introduced new problems in the matter of harvesting. These varieties give a much heavier tonnage but, largely in consequence, are subject to lodging whereby the standard harvesters of the past are able to cut daily only approximately half of the 12 acres formerly cut and the grower has difficulty in fulfilling his daily quota of cane. B. C. THOMSON describes the formation of a committee of processors and growers to consider the position, and traces very briefly the history of mechanized harvesting from 1938, when the Thomson Machinery Co. introduced a 2-row cutter. The major objection to this machine was its 12 ft tread, too broad for the narrow headlands and bridges, and a single row cutter was introduced. Now a new 2-row harvester has been designed and first tried in the 1957 harvest. It cuts 80% more cane than the older machine and, to work in conjunction with it, there has been designed a Scroll Piler which rolls the cane into bundles ready for lifting with the minimum of dirt.

Borer Control

At the 1957 Meeting of the Society, A. L. DUGAS described a system of borer control based on weekly surveys and subsequent mapping[1]. At the present session he reviewed the whole complex problem of control, complex because of the many factors involved. There are the basic facts that the borer passes through some four generations in a season and that, more than any other pest, it is subject to a very effective natural control by a number of parasites, particularly *Trichogramma*. There is, further, the fact that the successive generations of the borer attack cane at different stages of growth ; total percentages of infestation (joints bored) at harvest may, therefore, bear little relation to the actual damage done. Late infestation will be concentrated on the upper joints which are least important as productive of sugar. A further fact that must be taken into account in any control measure involving the use of insecticides is the interaction between the particular insecticide and the natural enemies of the borer. The evidence indicates that "Ryania" does not destroy these, but increased borer infestation at harvest has been found as the result of the use of DDT, BHC, "Chlordane", "Parathion" and "Toxaphene" through the prevention of a build-up of *Trichogramma* late in the season. Of all the insecticides tested for control of the second and third generations, "Endrin" (2% gran) applied bi-weekly appears to be the most effective, followed by "Toxaphene" and "Ryania".

A balance, thus, has to be established between the use of insecticides and *Trichogramma*, artificially bred and released, and this raises the important question of cost. A programme involving reliance on insecticides alone through their general use over the whole cane area and throughout the season would almost certainly be uneconomic. As in the case of all pests and diseases, damage is not evenly distributed but localized as soil conditions or micro-climate dictate. The most economical control will be one based on regular surveys conducted at short intervals.

Growth Stimulation

The gibberellins, of which gibberellic acid is the one used in the work here described by R. E. COLEMAN, are a group of substances derived from the fungus *Gibberella fujikuroi*, a pathogen of rice, and became known to the Japanese as early as 1926. Their physiological effect is growth stimulation, but there are a number of other responses. In sugar cane, the most obvious effect is internodal elongation.

The experiments described here fall into two sections, those conducted in the greenhouse and those in the field. In the former, single-eye setts soaked for 5 hr in a 5 or 10 p.p.m. solution of the acid showed an average increase in height of 56% after 23 days ; thereafter the rate of growth levelled off and, at harvest at 112 days, there was no significant difference in height, though, in the case of one of the two varieties tested, there was a significant difference in fresh weight but in favour of the untreated control. Subsequent spraying after the 47th day, at 21 days interval, however, resulted in significant increases both in height and weight.

[1] *I.S.J.*, 1957, **59**, 271.

In the field, repeated spraying of the acid at rates from 10 p.p.m. rising successively to 100 p.p.m. increased the plant height by 30 inches but the millable cane length by 10 inches only, with no effect on yield (cane tons/acre), sucrose or juice purity. There was, however, evidence of a pronounced increase in height during extremely cool conditions which prevailed in November. The extent of flowering was, under these circumstances, reduced and it may be that, as other workers have suggested, the acid replaces the long day requirement for flowering.

H.M.-L.

AGRICULTURAL ABSTRACTS

On Quantities of Potash Fertilizer. F. T. TABAYOYONG and F. A. BASILA. *Sugar News* (Philippines), 1958, **34**, 285–288.—In this release, No. 18 of the Victorias Milling Co., dressings of potash are noted as giving increases in the yield of sugar but not of cane. Of the three dressings, 100, 150 and 200 kilos per ha, the largest was the most profitable. There appeared to be a different response in the case of the two varieties grown, CP 29/116 and H 37–1933.

* * *

Cane Diseases and Pests and their Control. F. T. TABAYOYONG. *Sugar News* (Philippines), 1958, **34**, 343–349.—In Victorias Milling Co's. release No. 17, a review is given of the range of pests and diseases influencing the cane crop, the counter-measures adopted and a measure of the success achieved.

* * *

Availability of Phosphorus in Soils. J. S. MOLINA and C. SAUBERÁN. *Mother Earth*, 1958, **10**, 325–329.—A new method, involving the culture in Petri dishes of *Azotobacter* in a medium of soil + dextrine or starch on which phosphatic material is pin-pointed, is used to determine the availability of phosphorus in Argentine soils. The virgin soils of the Pampa region in general possess adequate supplies of phosphorus ; in cultivated soils the supply is normally deficient. Comparisons of the two local practices, stubble turned-in or burned before ploughing, show adequacy and deficiency of available phosphorus respectively. The conclusion is drawn that organic matter is an active promoter of the release of bound phosphorus.

* * *

Sugar Cane in Uganda. *East African High Commission Regional Research Programmes*, 1958–1959. (Nairobi, 1958), 83 pp.—According to this programme Uganda plans to conduct sugar cane research at the Robusta Coffee Research Station, Kituza. The East African Plant Quarantine Station (Kenya) imports new varieties, mainly from South Africa, which are kept in close quarantine for one year and then sent to Kawanda (Uganda) under open quarantine. These are then made available for testing in the other East African territories. Ratoon stunting disease is of some importance in the sugar-cane growing areas around Lake Victoria. A study of the symptoms of the disease and the losses it causes is proposed.

Evaluation of Sugar Cane Varieties, 1956 and 1957 Grinding Seasons. C. W. STEWART. *Louisiana State Univ. Engineering Experiment Sta. Bull.*, 1958, (63), 42 pp.—If yield of cane per acre and quality and quantity of the juice are the dominant factors in determining the value of a particular variety, they are not the only ones ; behaviour in the mill is not without its influence. In the experiments described three newly released varieties, CP48–103, NCo 310 and CP47–193 are compared with a standard, CP44–101, both as plant and stubble and over two years on the basis of the eight characters, sucrose % cane, sucrose % normal juice, purity normal juice, sucrose extracted % sucrose in cane, theoretically available 96° sugar (lb per ton) cane grinding rate (t/hr), fibre % cane, total mill power (kWh/ton cane). Two ton samples from crops grown under comparable conditions were ground in the Audubon factory under standard control procedures. The results are set forth in great detail in 33 tables.

To obtain an over-all comparison covering the eight characters, the value of such of these, as determined for each variety, is expressed in terms of the value of the standard taken as 100, the eight values thus obtained added and the totals divided by eight. As an example, the over-all varietal rating for plant cane, season 1956, is : CP44–101, 100 ; CP48–103, 108·71 ; N : Co 310, 104·90 ; CP47–193, 102·72. In certain tables three further determinations are included: kWh/ton 96° sugar, bagasse % cane and bagasse % sucrose. In addition, ratings are given for the 1957 plant crop of three unreleased varieties, CP52–57, CP52–67 and CP52–68.

For the three newly released varieties data are available for the six years, 1952–1957, and, on average, CP48–103 leads at 109·64 seasonal range (102·80—117·13). Emphasis, however, is laid on the fact that the results so far are only indicative and not conclusive. Notably, the eight (or eleven) characters selected are unweighted, yet they are unlikely to carry equal weight in determining the over-all value of a variety. Thus, it is pointed out, CP52–67 is higher than the standard in all eleven characters except fibre % cane (99·01), and has an overall rating of 105·08 ; CP52–68 is below standard in three of the eleven characters, sucrose extraction (99·21), bagasse % cane (97·38) and bagasse % sucrose (86·37) and has an over-all rating, 104·19, below that of CP52–67. Yet CP52–68 would appear to be the superior variety owing to the high % figure (117·66) for available 96° sugar/ton cane.

Variety Schedule in Improving Sugar Recovery Per Cent Cane. S. K. CHOPRA. *Indian Sugar*, 1958, **7**, 767–768.—Sugar recovery % cane in the western tract of Uttar Pradesh is given and shows no improvement over the last seven years ; the increased production is accounted for by a 50% increase in area under cane between 1932–33 and 1955–56. Improvement is sought in varietal sequence ; CoS 321 for crushing between 1st November and 15th February, CoS 245 between 15th February and 31st March and Co 421 and Co 356 during April and May.

* * *

A Plea for the Successful Application for Hand Refractometer on Pre-harvest Maturity Scheme from Experiences. S. C. SEN. *Indian Sugar*, 1958, **8**, 325–330.—The system, with its objective of securing a regular supply of mature cane from a host of small growers, was discussed in a series of papers at the 28th Annual Convention, Sugar Technologists' Association of India, 1957[1]. The plea is here repeated and a set of 27 suggestions enumerated.

* * *

Influence of the Inclination of Cane Stalks on their Juice Quality. ANON. *Ind. J. Sugarcane Res. Dev.*, 1958, **2**, 134–137.—A significant decrease in the sucrose % juice, and increase in the reducing sugars is shown to occur with increasing inclination of the stem from the vertical.

* * *

Correlation between Size of Holdings and Average Yield per Acre. S. S. IYER. *Ind. J. Sugarcane Res. Dev.*, 1952, **8**, 146–150.—Analysis of over 700 holdings ranging between under 2 and 30 acres showed no correlation.

* * *

Effect of Phosphorus Deficiency on Various Nitrogenous Fractions of Sugar Cane. K. N. LAL and J. N. SINGH. *Ind. J. Sugarcane Res. Dev.*, 1958, **2**, 151–160.—Variations are recorded in several nitrogenous fractions in the leaf, stem and root of sugar cane grown in sand culture as between a complete and P deficient medium. The determinations cover the ages 45, 90, 135 and 225 days.

* * *

***Adsali* Crop of Sugar Cane in Bombay State.** H. R. ARAKERI *et al. Ind. J. Sugarcane Res. Dev.*, 1958, **2**, 167–171.—*Adsali* is a Marathi word meaning 18 months and an *adsali* crop is one planted in July—August and harvested 18 months later. The advantages are increased yield, early maturity and reduced costs of cultivation in spite of increased irrigation. The cultural system with alternative rotations is here described. The system is gaining in popularity.

* * *

A New Leaf Disease in U.P. KIRTI KAR and D. R. SINGH. *Ind. J. Sugarcane Res. Dev.*, 1958, **2**, 129–133. —The characteristics of this disease, first noticed in 1955 in the western Uttar Pradesh, are etiolated leaf streaks followed, in the rains, by stunting and ultimate drying out in December. A virus is suspected.

* * *

Common Sugar Cane Mealybugs in Bihar. S. MOHAMMAD ALI. *Ind. J. Sugarcane Res. Dev.*, 1958, **2**, 179–183.—With the object of clearing up confusion between species of mealybugs (*Coccidae*) attacking sugar cane, a study of those found in Bihar was undertaken. Three species are recognized: *Ripersia sacchari*, *Saccharicoccus sacchari* and *Pseudococcus saccharifolii*.

* * *

Sugar Cane Rust in Bombay. M. J. ALBUQUERQUE and H. R. ARAKERI. *Ind. J. Sugarcane Res. Dev.*, 1958, **2**, 199–203.—Rust first assumed major importance with the outbreak in 1949 on Co 475. Observations under natural and artificial conditions suggest the presence of more than one physiological race.

* * *

Effect of "Endrin" on the Incidence of Sugar Cane Leaf-hoppers. D. K. BUTANI. *Ind. J. Sugarcane Res. Dev.*, 1958, **2**, 204–207.—A considerable reduction in infestation is recorded in much detail as the result of spraying 0·5 lb "Endrin" (19·5% concentration) per acre over two areas, each approximating to 70 acres, in the second half of June.

* * *

A Preliminary Survey of the Plant Mites of Puerto Rico. H. L. CROMROY. *J. Agric.* (Univ. Puerto Rico), 1958, **42**, 39–144.—This is a detailed taxonomic study of 4 families of the *Acarina* Order of the Class *Arachnida*. A single species, *Oligonychus sacchari* (McGregor) is recorded on cane.

* * *

Results of Sugar Cane Variety Tests in Louisiana, 1957. R. J. MATHERNE and L. P. HEBERT. *Sugar Bull.*, 1958, **36**, 270–283.—The results of a large number of experiments covering numerous varieties grown under differing conditions are given in 9 tables. Expecially noteworthy are CP48–103 for juice quality, N:Co 310 for yielding ability and the as yet unreleased CP 52–68 for its yield and, in particular, its juice quality. CP44–101, accepted generally as standard, maintains its productivity.

[1] *I.S.J.*, 1958, **60**, 350.

MILL TORQUE AS A FUNCTION OF ROLL LOADING

PART II.—Development of Dimensional Analysis

By C. R. MURRY

6. Dimensional Analysis for N

Since N is a dimensionless quantity, investigation by the methods of dimensional analysis is suggested. The following quantities are normally known for a first mill, viz.:

q — crushing rate per foot width of roll.

d_o — no-void density of cane approaching mill.

W_o — work opening (delivery side).

D — roll diameter.

S — roll surface speed.

Crushing rate will be considered in terms of cane since this appears, to the author, to be a sensible measure for the first mill. Admittedly this takes no account of the fibre percentage in the cane. The no void bulk density is almost constant for all canes, the value being approximately 71 lb/cu.ft. The actual value may be easily calculated for cane of any given composition. The surface speed has been included although it has already been suggested that it does not affect the value of N. No attempt will be made, at present, to include the degree of preparation of the cane.

Let g = roll torque per foot width of roll

r = roll load per foot width of roll.

Using units of M = mass, L = length and T = time the dimensions of the above quantities are set out in table 4.

Table 4

	M	L	T	Index
q	1	−1	−1	a
d_o	1	−3		b
W_o		1		c
D		1		d
S		1	−1	e
g	1	1	−2	
r	1		−2	

Suppose that for g an equation of the form below holds :

$$g = A\, q^a\, d_o^b\, W_o^c\, D^d\, S^e$$

where A is some dimensionless constant and a, b, c, d, e are constant indices. Then the equations for dimensional homogeneity are :

For M : $\quad 1 = a + b$

For L : $\quad 1 = -a - 3b + c + d + e$

For T : $\quad -2 = -a - e$

Whence $a = 1 - b$

$d = 1 + b - c$

$e = 1 + b$

Hence the dimensionless equation 12 below may be formed.

$$\frac{g}{qDS} = A \left[\frac{q}{d_o SD}\right]^{-b} \left[\frac{W_o}{D}\right]^c \qquad \ldots\ldots (12)$$

Similarly it may be shown that :

$$\frac{r}{qS} = B \left[\frac{q}{d_o SD}\right]^f \left[\frac{W_o}{D}\right]^h \qquad \ldots\ldots\ldots (13)$$

where B, f and h are constants similar to A, b and c. From 12 and 13 we have :

$$N = \frac{g}{rD} = K \left[\frac{q}{d_o SD}\right]^u \left[\frac{W_o}{D}\right]^t \qquad \ldots\ldots (14)$$

where K, u and t are constants.

Now compression ratio has been defined by Bullock [2,7] as :

$$C = \frac{q}{d_o S W_o}$$

hence

$$N = K \left[C \frac{W_o}{D}\right]^u \left[\frac{W_o}{D}\right]^t$$

or (putting $v = u + t$)

$$N = K\, C^u \left[\frac{W_o}{D}\right]^v \qquad \ldots\ldots\ldots\ldots (15)$$

The degree of preparation will, most probably, affect the value of K. That is, K is a function of preparation and other variables—*not* a true constant. The above analysis confirms that N is independent of speed except insofar as compression ratio depends on speed.

7. Comparison of Equations 9 and 15

The dimensional analysis does not appear, at first glance, to agree with Hugot's theory as presented in equation 9. However a further analysis of equation 9 may be made. Since Hugot is calculating from press tests he assumes that the bagasse volume is equal to the escribed volume. On this basis the quantity $\frac{J}{Fd}$ may be simplified as follows :

By definition $J = \frac{qf}{SD}$

The weight of fibre per unit time $= qf$

Hence $F = \frac{qf}{m}$ where m is the weight of material leaving the mill per minute.

$$d = \frac{m}{\text{escribed volume per unit time}} = \frac{m}{W_o S}$$

Hence $\frac{J}{Fd} = \frac{qfmW_oS}{SDqfm} = \frac{W_o}{D}$

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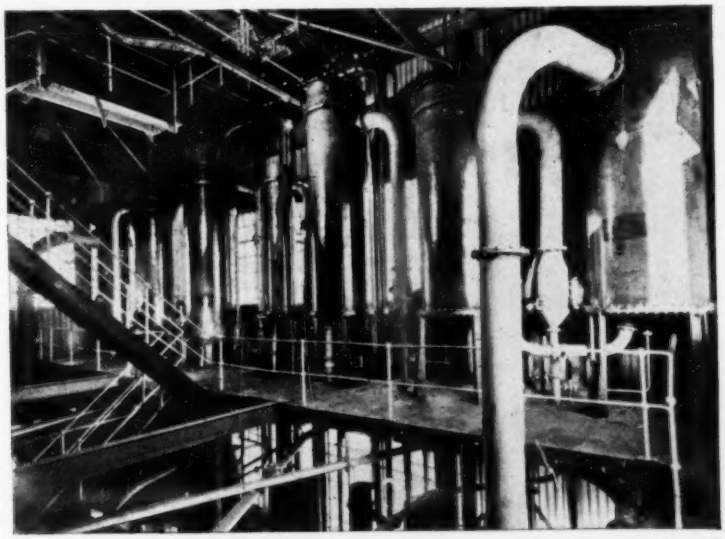

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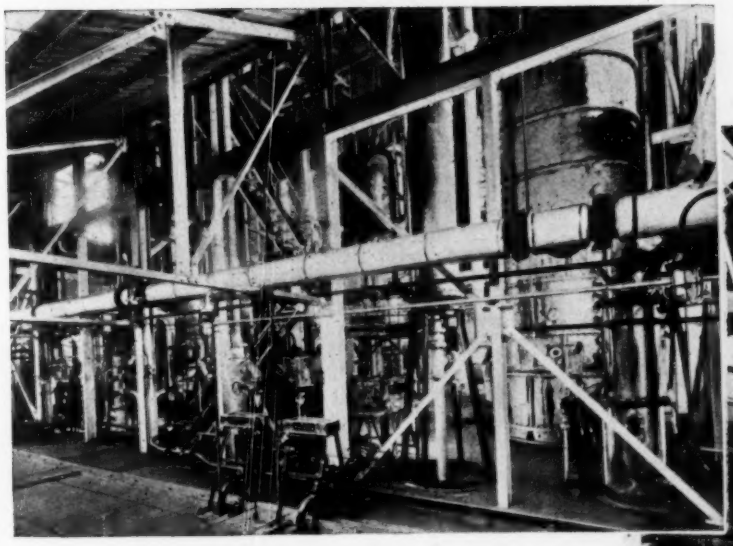

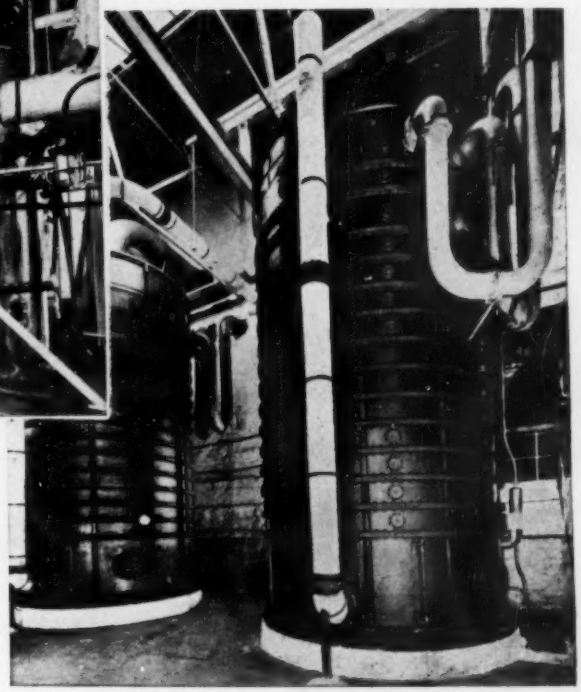

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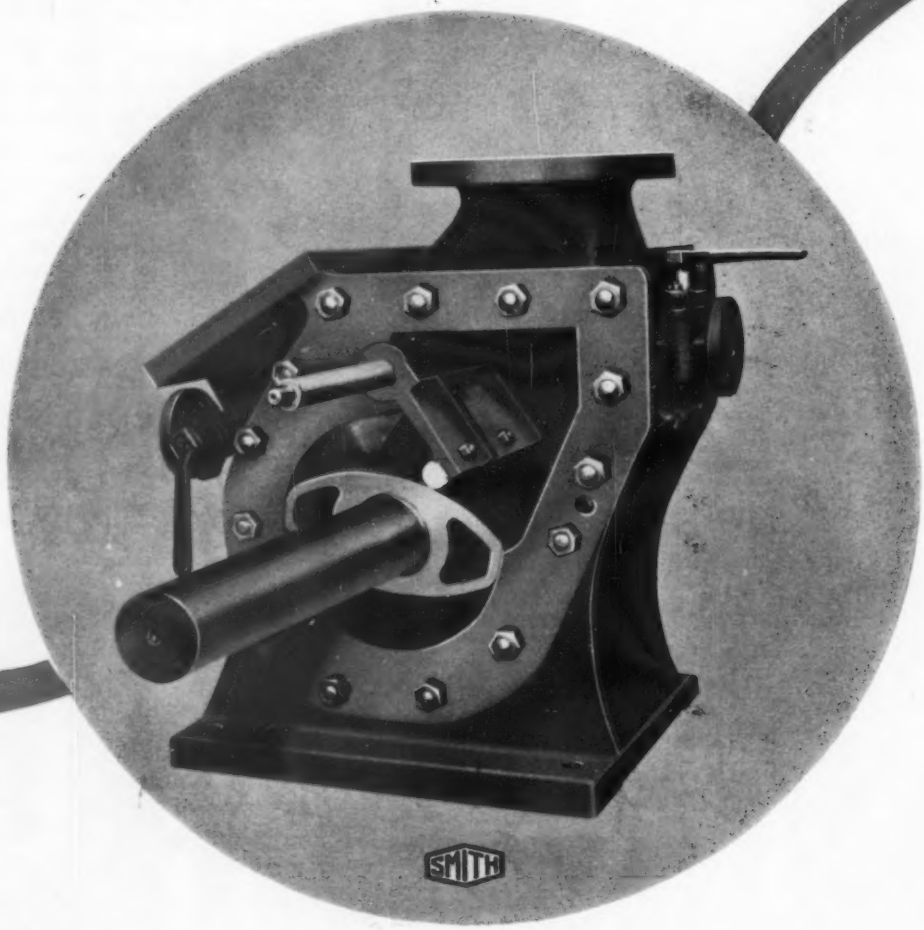

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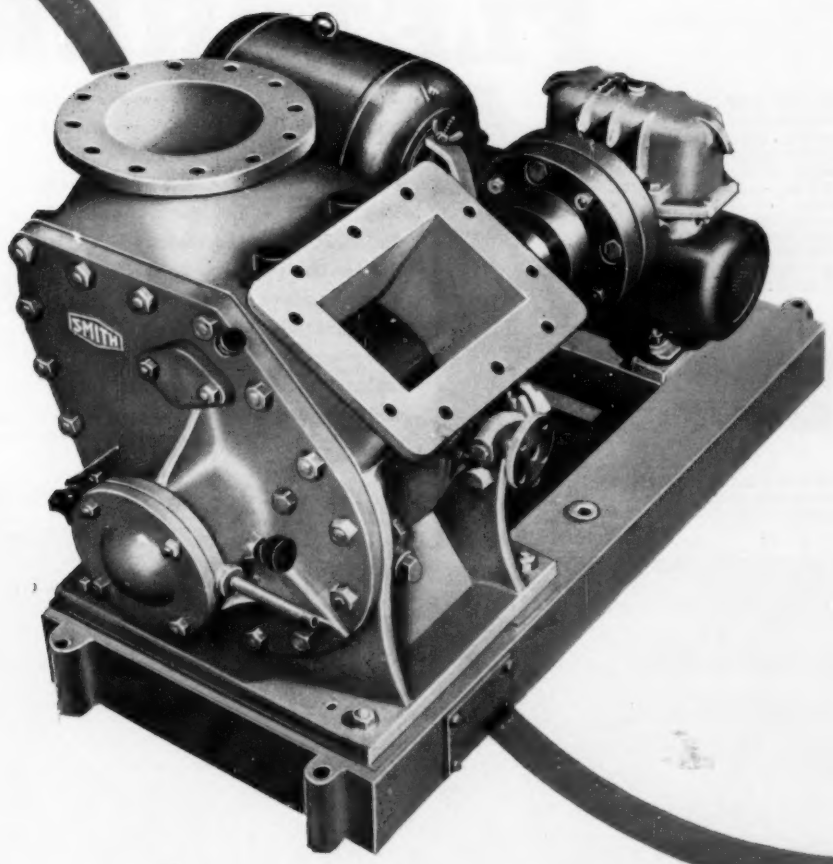

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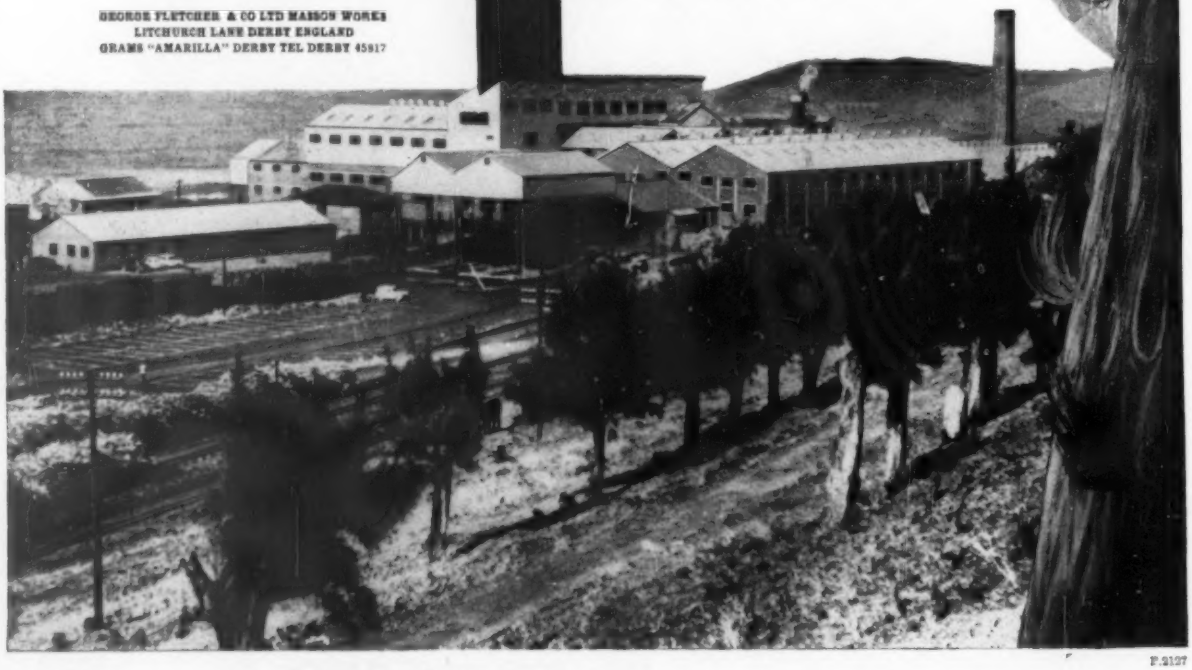

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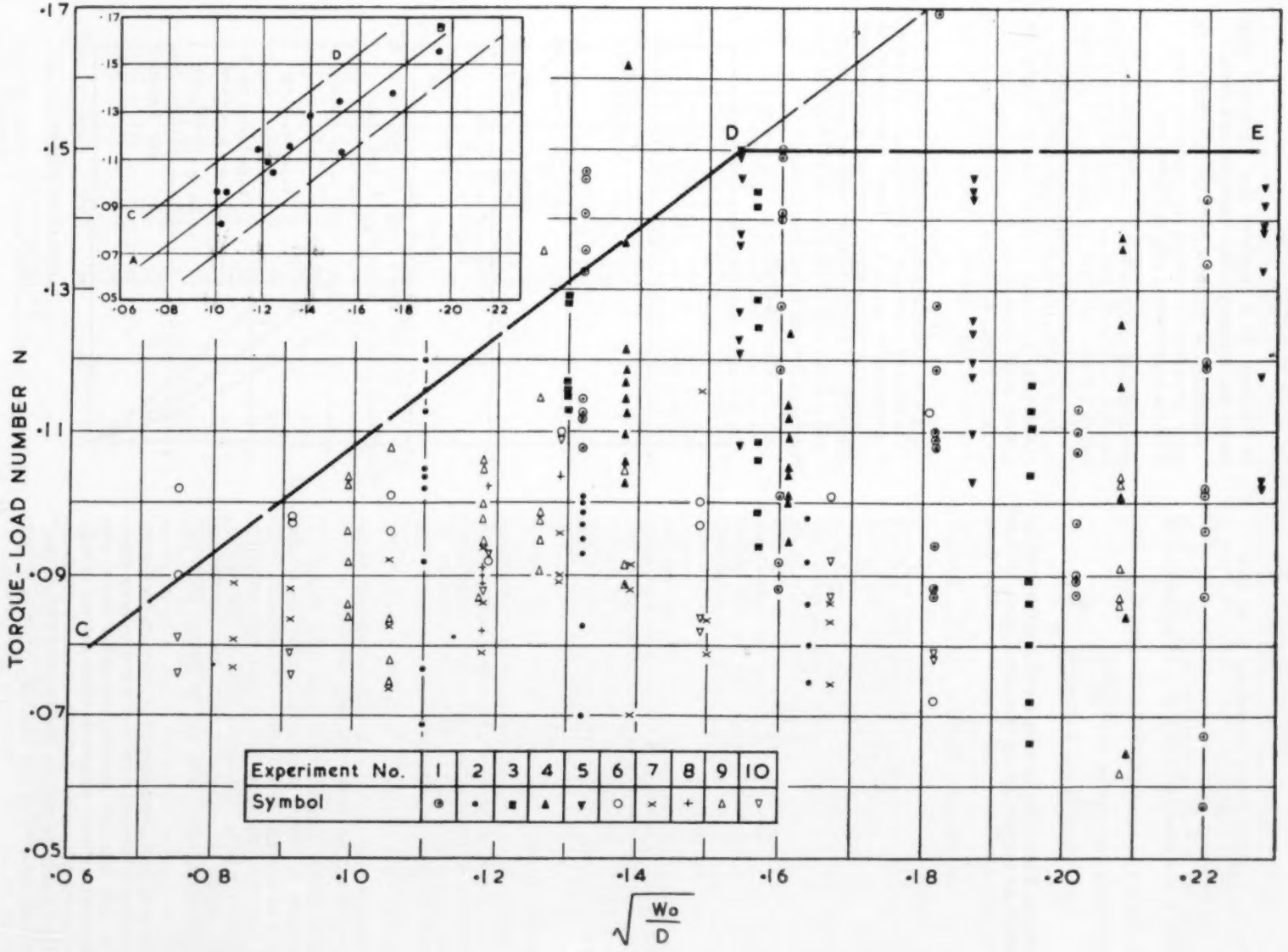
TORQUE-LOAD NUMBER N
$\sqrt{\frac{W_o}{D}}$
C
D
E
Experiment No. 1 2 3 4 5 6 7 8 9 10
Symbol

Fig. 3.

That is, equation 9 may be reduced to the form

$$N = \lambda \sqrt{\frac{W_o}{D}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (16)$$

where λ is a practical "constant". This suggests that the index v of equation 15 may be equal to $\frac{1}{2}$. This assumption can now be investigated.

8. Torque-Load Number *vs.* $\sqrt{\frac{W_o}{D}}$

Figure 3 shows a plot of values of N taken from the individual tests of the experiments of table 1. It is immediately obvious that N does not depend on $\sqrt{\frac{W_o}{D}}$ alone and that, therefore, Hugot's theory is incomplete.

However some interesting inferences may be drawn from figure 3. The line AB is the line of regression of points obtained from an experiment at maximum capacity for hand feeding conditions. This experiment has not been previously reported and the results are set out in Appendix I. The two lines parallel to AB are the 95% statistical confidence limits for the line of regression. It will be seen that the upper limit forms a reasonable boundary for all the points plotted. Only 10 of the 270 (approx.) points plotted fall above this boundary.

It is suggested that the lines CD, DE represent the values of N beyond which it is normally impossible to operate the experimental mill. In considering this hypothesis it is necessary to remember that N may be considered as an "effective coefficient of friction along the arc of contact of the roll." For small work opening:diameter ratios $\left(\frac{W_o}{D}\right)$ the arc of contact is short and the effective friction build-up is limited by this factor. It may be that some change in form of the pressure curve takes place as the work opening-diameter ratio decreases. This is the condition to the left of point D which represents a work opening: diameter ratio of 0·024. At greater $\frac{W_o}{D}$ ratios the maximum value of N for the mill would have to be exceeded and this is not normally possible.

It is further suggested that some feed pressure is necessary to obtain reasonable extractions in the region to the right of point D. Very few points from the hand fed experiments fall in this region and those that do are from experiments with low extractions. This matter is connected with the concept of "compression ratio" and will be further discussed later.

Since N is of the nature of an effective coefficient of friction it is easy to see that it may take up some value less than the maximum possible value. An occasional test may also arise where contact is very good or the entry and roll speeds are *exactly* matched. In these cases the effective coefficient of friction may approach the limiting case and high values of N may be obtained. It is suggested that the points lying above the boundary CDE represent such tests.

Accepting that the above hypothesis is sound we may write inequalities governing the maximum values of N in the experimental mill as follows :—

$$N \not> 0{\cdot}75 \sqrt{\frac{W_o}{D}} + 0{\cdot}03 \qquad \ldots\ldots\ldots\ldots\ldots (17)$$

and $N \not> 0{\cdot}15$

9. Further Investigation of Equation 15

Assuming the index $v = \frac{1}{2}$, equation 15 may be written in the form :

$$\lambda = \frac{N}{\sqrt{\frac{W_o}{D}}} = KC^n \qquad \ldots\ldots\ldots\ldots\ldots\ldots (15a)$$

The quantity λ may now be investigated as a function of compression ratio C. Three experiments at constant preparation were selected and log λ correlated against log C. This correlation is set out in Appendix 2, and a linear plot of the points is given in figure 4. The equation to the line of best fit is :

$$\lambda = 0{\cdot}35\ C^{0{\cdot}74}$$

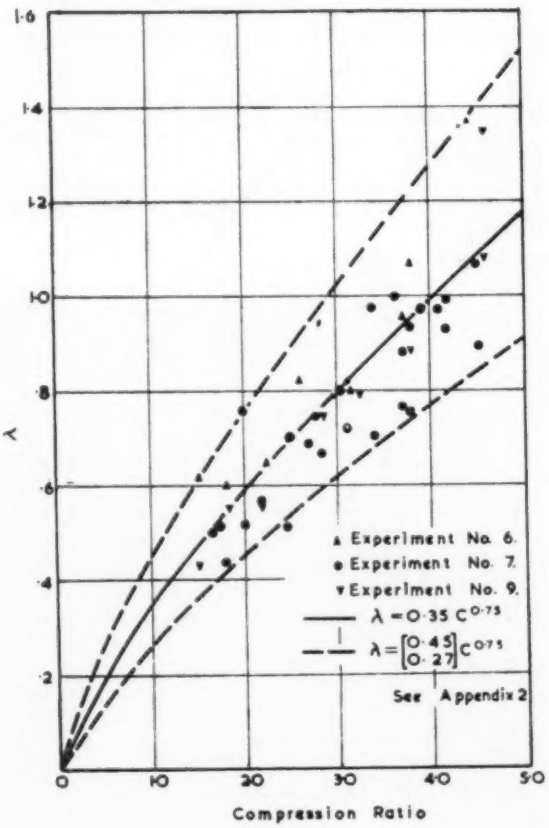

Fig. 4.

Equation 15 may now be re-written using $u = 0{\cdot}75$ as a trial value. We have :

$$N = K\,C^{\frac{1}{2}}\sqrt{\frac{W_o}{D}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (15b)$$

The quantity K may now be investigated assuming equation 15b to hold. For this purpose an extensive experiment performed by BULLOCK and the author was selected. It is listed as experiments 2, 3, 4 and 5 in table 1 and has been completely reported elsewhere[8]. Calculated values of K from the experimental results and using equation 15b are given in table 5. The analysis of variance of K is given in table 6. Examination of tables 5 and 6 shows that K is independent of speed, feed depth (work opening) and compression ratio. This supports equation 15b. The mean values of K for the three preparations may be calculated. They are listed in table 7.

Table 5

VALUES OF K FROM EXPERIMENTS 2, 3, 4 & 5.

	P_1			P_3			P_5		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
C_1—									
F_1 ..	0·34	0·32	0·34	0·42	0·36	0·44	0·45	0·36	0·39
F_2 ..	0·30	0·33	0·39	0·33	0·45	0·43	0·43	0·25	0·27
F_3 ..	0·48	0·42	0·36	0·23	0·45	0·36	0·45	0·49	0·30
F_4 ..	0·43	0·33	0·33	0·47	0·38	0·45	0·47	0·45	0·46
C_2—									
F_1 ..	0·42	0·40	0·29	0·38	0·45	0·40	0·34	0·41	0·39
F_2 ..	0·38	0·33	0·34	0·37	0·43	0·43	0·45	0·50	0·49
F_3 ..	0·34	0·35	0·36	0·37	0·38	0·38	0·42	0·33	0·37
F_4 ..	0·30	0·32	0·35	0·36	0·34	0·37	0·42	0·43	0·42
C_3—									
F_1 ..	0·37	0·42	0·28	0·31	0·45	0·42	0·41	0·46	0·48
F_2 ..	0·39	0·36	0·41	0·39	0·41	0·38	0·44	0·40	0·44
F_3 ..	0·37	0·35	0·44	0·33	0·36	0·37	0·39	0·38	0·52
F_4 ..	0·35	0·39	0·36	0·31	0·43	0·35	0·42	0·39	0·43

C = Compression Ratio $C_1 = 1{\cdot}5$, $C_2 = 2{\cdot}25$, $C_3 = 3{\cdot}0$

P = Preparation as in Table 1

S = Speed $S_1 = 25$ f.p.m., $S_2 = 42$ f.p.m., $S_3 = 60$ f.p.m.

F = Feed Depth $F_1 = 2$ inches, $F_2 = 3$ inches, $F_3 = 3\frac{1}{2}$ inches, $F_4 = 4$ inches

Table 6

ANALYSIS OF VARIANCE.
VALUES OF ($K \times 100$) FROM EXPERIMENTS 2, 3, 4 & 5.

Source	Degrees of Freedom	Sum of Squares	Mean Square	Variance Ratio F	Significance Level
C	2	8	4	—	—
F	3	7	4	—	—
P	2	481	240	11·2	0·001
S	2	8	4	—	—
CF	6	359	60	2·8	0·05
CP	4	124	31	1·4	—
CS	4	119	30	1·4	—
FP	6	219	37	1·7	0·20
FS	6	42	7	—	—
PS	4	209	52	2·4	0·10
CFP	12	388	32	1·5	0·20
CFS	12	500	42	1·9	0·10
CPS	8	230	29	1·3	—
FPS	12	200	17	—	—
CFPS	24	515	21·5	—	—
Total ..	107	3409	—	—	—

Standard Error = 4·6
= 0·046 in units of K.

Note the general agreement between this error and that of the line in appendix 2.

Table 7

Preparation	K
Fibrated	0·36
Fine	0·39
Coarse	0·42

The quantity K may be a function of several different variables, e.g., preparation, roll diameter, surface condition of rolls, cane variety. Some of these variables and their likely effects are discussed below :—

Preparation—Roll diameter : Table 7 shows that K is a function of preparation but this function might depend on the roll diameter. It does not seem unlikely that a preparation which is coarse in a small diameter mill may be relatively finer in a large diameter mill. This interaction has not yet been investigated but experiments are planned with 22-in and 26-in diameter rolls. These experiments should indicate if the diameter effect is important.

Surface Condition of the Rolls : Since N may be thought of as a coefficient of friction, factors affecting coefficient of friction will influence N. However in most experiments the maximum value of N is not required (see figure 3) and so one may think of K as being independent of coefficient of friction. The coefficient of friction variations will be discussed later.

Cane Variety : K depends on the difficulty of crushing the cane. Coarse preparations are more difficult to crush than fine preparations hence K is greater for coarse preparations than for fine (table 7). The author suspects, therefore, that K is also a function of cane variety, but no experimental evidence of this is available. It would be difficult, in any case, to distinguish between variety and preparation effects. The difficulty of measuring preparation is well known. The most recent attempts to measure preparation have used the bulk density of a sample at standard conditions of pressure[6, 12]. This method of measurement is, of course, arbitrary and it is difficult to see how any method which is not of an arbitrary nature can be evolved. This inability to measure preparation at present prevents differentiation between cane variety and preparation effects.

10. ROLL SURFACE CONDITION

Many factors influence the coefficient of friction between cane or bagasse and metal surfaces. It has been shown[3, 13] that the coefficient of friction varies with roll grooving, degree of cane preparation, and rubbing speed as well as the normal bagasse load per unit area (equation 11). Speed has been shown not to affect the value of N. This is reasonable since the relative speed between the cane mat and the rolls must be very close to zero under satisfactory condi-

[12] ANON : "Assessing the Degree of Cane Preparation". *Tech. Report* (*Sugar Research Institute, Queensland*), 1958, (48).

[13] BULLOCK & MURRY : *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 81–88 ; *I.S.J.*, 1958, **60**, 162–164.

tions of operation. With fresh cane it has been shown[13] that the limiting coefficient of friction is relatively unaffected by changes in preparation. Hence the *maximum* value of N *might* be independent of preparation. It is convenient to think of all the preparation effect being concentrated in the factor K of equation 15b. Roll grooving stands apart as being a factor likely to affect the *maximum* value of N.

In addition recent experiments carried out at this University[14] suggest that the coefficient of friction depends, to some extent, on the surface roughness of the rolls. This factor will, then, have some influence on the maximum value of N attainable. Since the maximum value of N is a measure of the feeding ability of the mill (see later) both roller grooving and surface condition will have an important effect on mill feeding. This view has long been held by "practical" mill engineers and recent papers[15, 16] make reference to this matter. *To be continued.*

Appendix 1

Work Opening Inches	Max. Crushing Rate lb/min/ft	Max. Compression Ratio *	N	$\sqrt{\frac{W_o}{D}}$
0·18	140	5·50	0·098	0·100
0·19	139	5·10	0·082	0·102
0·20	139	4·95	0·098	0·105
0·25	151	4·23	0·114	0·118
0·27	152	3·98	0·109	0·122
0·28	150	3·75	0·104	0·124
0·31	163	3·70	0·115	0·131
0·35	185	3·74	0·129	0·140
0·42	162	3·75	0·136	0·153
0·43	146	2·36	0·113	0·154
0·55	176	2·23	0·139	0·175
0·69	187	1·91	0·156	0·195

* Approx. only—not corrected for roll slip.

Correlation of N *vs.* $\sqrt{\frac{W_o}{D}}$ gives the line

$$N = 0{\cdot}754 \sqrt{\frac{W_o}{D}} + 0{\cdot}014$$

The coefficient of correlation for this line is $r = 0{\cdot}923$ which is significant at the 0·001 level.

For $p = 0{\cdot}05$ Student's $t = 2{\cdot}23$ for 10 degrees of freedom. The residual standard deviation about the line in units of N is 0·00837 whence the 95% "confidence limits" are approximately $\pm$ 0·0187.

Appendix 2

The results are taken from Tables 81, 86 and 88 of Bullock's thesis[2]. The experimental conditions are as follows :

Table 81—as for experiment No. 7, Table 1 of this paper.

Table 86—as for experiment No. 9, Table 1 of this paper but using the P_3 results only.

Table 88—as for experiment No. 6, Table 1 of this paper but using the P_3 results only.

The values of N and $\sqrt{\frac{W_o}{D}}$ calculated from these results and the compression ratios are tabulated below :

N	$\sqrt{\frac{W_o}{D}}$	λ	C
	From Table 81		
0·083	0·167	0·497	1·57
0·086	0·167	0·515	1·68
0·074	0·167	0·443	1·78
0·113	0·149	0·760	1·96
0·079	0·150	0·526	2·04
0·084	0·149	0·565	2·19
0·088	0·139	0·634	2·19
0·092	0·139	0·662	2·28
0·070	0·139	0·504	2·45
0·090	0·129	0·700	2·50
0·089	0·129	0·690	2·70
0·096	0·129	0·745	2·80
0·079	0·118	0·670	2·86
0·094	0·118	0·797	3·04
0·086	0·118	0·730	3·16
0·075	0·105	0·715	3·38
0·092	0·105	0·880	3·66
0·083	0·105	0·770	3·67
0·095	0·097	0·980	3·30
0·095	0·097	0·980	3·90
0·097	0·097	1·000	3·60
0·088	0·091	0·970	4·1
0·081	0·091	0·890	4·5
0·085	0·091	0·934	3·8
0·082	0·083	0·990	4·2
0·077	0·083	0·930	4·2
0·089	0·083	1·070	4·5
	From Table 88		
0·113	0·182	0·620	1·54
0·101	0·167	0·605	1·81
0·095	0·149	0·638	2·16
0·108	0·129	0·838	2·72
0·094	0·118	0·798	3·14
0·102	0·105	0·971	3·66
0·097	0·091	1·067	3·84
0·102	0·075	1·360	4·37
	From Table 86		
0·078	0·182	0·430	1·5
0·092	0·167	0·550	1·8
0·084	0·149	0·565	2·2
0·095	0·129	0·736	2·9
0·093	0·118	0·788	3·3
0·080	0·105	0·762	3·8
0·080	0·091	0·880	3·8
0·081	0·075	1·080	4·6
0·087	0·065	1·340	4·7

The correlation of $\log \lambda$ *vs.* $\log C$ gives :

$$\log 10\,\lambda = 0{\cdot}742 \log C + 0{\cdot}54$$

The residual standard deviation about the line in units of $\log 10\,\lambda$ is 0·055. Student's t for $p = 0{\cdot}05$ and 42 degrees of freedom is 2·02 and the 95% "confidence limits" are approximately $\pm$ 0·111. Hence we may write :

$$\lambda = \left\{ 0{\cdot}35 \begin{matrix} + 0{\cdot}10 \\ - 0{\cdot}08 \end{matrix} \right\} C^{0{\cdot}74}$$

and the area represented by these limits can be expected to take in 95% of all points from experiments similar to those used for the correlation. It is this area which is drawn on figure 4.

[14] Unpublished data.
[15] Donnelly : *Proc., 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 83–91; *I.S.J.*, 1959, **61**, 83.
[16] Allan : *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 65–73; *I.S.J.*, 1959, **61**, 83.

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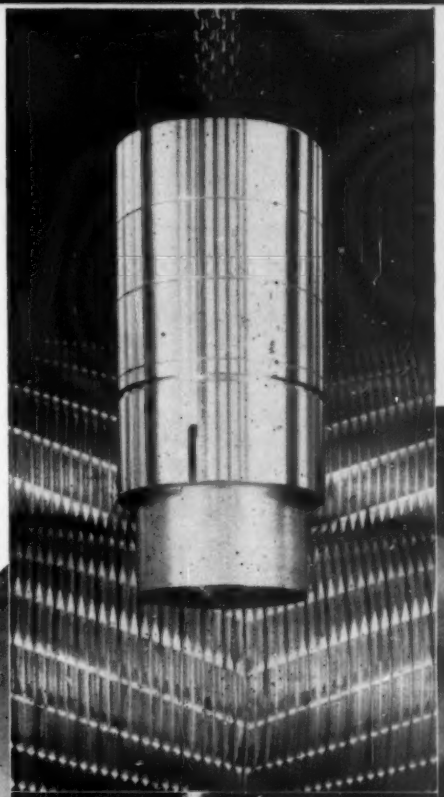

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THE FACTORS AFFECTING STABILITY AND FLOCCULATION IN CANE JUICE

By M. C. BENNETT

(Department of Sugar Chemistry and Technology, Imperial College of Tropical Agriculture, Trinidad, W.I.)

PART I.

INTRODUCTION

THE stability of a suspension is generally assessed by observing the sedimentation of its dispersed phase ; apparently stability is governed to a large extent by the size-density relationship of the sedimenting units. In raw cane juice the suspended particles differ widely in both composition and size and they therefore show a wide range of sedimentation rates. While the largest ($> 10\mu$) particles are unstable and settle out in only a few minutes, the smallest ($1–2\mu$) particles remain in stable suspension for many hours, so that in order to effect a rapid phase separation in juice it is necessary to bring about particle aggregation.

In the flocculated system, large and small particles alike are bound together into new sedimenting units and, provided flocculation is complete, the dispersed phase can now be regarded as homogeneous. If flocculation is not complete, then single particles will remain in free suspension and the stability of the juice system as a whole must be assessed not only in terms of the sedimentation of flocculated material but also in terms of the clarity of the supernatant layer. It is this latter facet of stability which forms the subject of the present work ; sedimentation behaviour will be discussed in subsequent papers. Attention is here focused upon the mechanism of flocculation and it is therefore necessary to consider the manner in which particle-to-particle adhesion takes place.

In highly charged lyophobic sols flocculation takes place below a certain critical zeta potential, the value of which generally lies between 20 and 40 mV. The colloidal stability of such systems has been described[1, 2] in terms of a quantitative combination of VAN DER WAALS attractive forces with repulsion of the electrical (GOÜY-CHAPMAN) double layers, and there seems no reason to doubt that these considerations also apply to oil/water emulsions[3]. In lyophilic systems or in particle dispersions stabilised by lyophilic material another stabilising factor is important, that is the repulsive action of solvation layers not necessarily connected with electrostatic charges. In these cases the stability of the system is determined to a large extent by the nature of the stabilising material, and significant differences are found between the effects of, for example, detergents and proteins.

It has been shown[4] that cane juice behaves electrophoretically as a homogeneous suspension of particles, the surfaces of which are generally found to be characteristically proteinaceous, and therefore juice lies in this second class of colloid systems. In the commercial clarification process, the changes which lead to destabilisation and consequent particle aggregation are usually brought about by boiling the juice after an addition of milk of lime. An approximate measure of the zeta potential of particles in their natural juice environment has recently been obtained and it has been shown that the value in raw juice, generally lying between 7 and 10 mV, is not decreased by more than 1 or 2 mV during the clarification reactions. It must be concluded that the stability changes made use of in the commercial process are dependent upon factors other than zeta potential, and that the very nature of the system has been changed.

In a previous paper[5] the author has demonstrated that it is the precipitation of calcium phosphate in the juice at pH values greater than 5·5 which produces a large destabilisation effect ; it was suggested that the flocs formed in the clarification process should be regarded as clusters of particles bound together in a matrix of the precipitated phosphate. However, calcium phosphate is by no means a universal flocculant in particle suspensions ; for example, it has been shown recently that the generation of a calcium phosphate precipitate in certain mineral slurries does not affect the stability of those systems. Clearly, a special relationship must exist between the precipitated calcium phosphate and the particles in cane juice. It is suggested that adhesion of particles to the phosphate precipitate takes place through calcium ions (and to a much lesser extent, other cations) which are already chemically bound to the particle by the adsorbed protein layer and, in one juice, the dissociation constant of the adsorbed calcium-protein complex has been determined[7]. Flocculation in cane juice by calcium phosphate precipitation is therefore dependent upon the existence at the particle surface of a substance which will form complexes with calcium ions, and this provides a possible mechanism by which different juices show different responses to calcium phosphate precipitation.

Previous investigations into the nature of the particle surface have shown that other charged material besides protein must be present at the particle surface in order to account for all the observed phenomena ;

[1] VERWEY and OVERBEEK ; "Theory of the Stability of Lyophobic Colloids" (Elsevier, Amsterdam), 1948.
[2] DERAJUIN and LANDAU : *Acta physicochim.*, 1941. **14**, 633.
[3] OVERBEEK : *Disc. Faraday Soc.*, 1954, (18), 192.
[4] BENNETT : *J. Colloid Sci.*, 1957, **12**, 434.
[5] *I.S.J.*, 1957, **59**, 208.
[6] EVANS, KUNDA AND CHIANG : *Canadian J. Chem. Eng.*, 1957, **35**, 25.
[7] BENNETT : *Chem. and Ind.*, 1957, 1098.

it was suggested that this material might be an acidic polysaccharide[4]. Thus, although protein is always present, there is the possibility that protein does not always make the major contribution to the stability of the system. The composition of material at the particle surface might vary from juice to juice and, indeed, in any one juice while it is being heated to boiling. It is well known that many raw juices are flocculated simply by boiling and it is therefore suggested that, during the heating, fresh layers of material are superimposed on the original surface and that these change not only the stability of the system as a whole but also the response of the system to a calcium phosphate precipitate.

In support of this suggestion, the formation of discrete flocs in an otherwise apparently normal juice can be prevented by the addition of starch to the raw juice before liming and heating; no phase separation then takes place for a considerable time. It is imagined that the proteinaceous surface of the particles is covered with a starch film which, being almost unreactive towards calcium, prevents particle adhesion. This "protective" action of starches is found with other systems,[8] and will be discussed in detail in a later paper. It is doubtful that such an extreme case of interference by starch is ever encountered naturally, but this does not preclude the possibility that other macromolecular substances produce a similar effect.

The work described below is a study of the relationship between suspension stability and the physical, rather than chemical, nature of the particle surface. It includes a consideration of the changes which take place during the clarification process, for instance, as the system is heated and subsequently boiled, and a comparison of these changes with those which take place in other juices on similar treatment. We have been fortunate to have available a selection of cane grown under drought conditions which, for Trinidad, were severe. On the basis of settling rates, mud volumes and clarities the juice from these canes would have presented serious difficulties in the factory; the B4098 juice referred to below was the most "refractory" natural system which has so far been examined in this laboratory. Effects have been detected in these juices which were not present in the juices we have used in earlier studies, and it is therefore the purpose of this paper to demonstrate some of the differences between normal and abnormal cane juice behaviour.

Experimental

Cane was milled in a laboratory three-roller mill and the juice filtered through cotton wool in order to remove coarse material. The filtration removed all particles of diameter larger than 6μ so that no sedimentation could be visually detected in the juice within 30 minutes. While the filtered raw juice system might have been chosen as the standard of stability, it would have been impracticable to detect differences between juices, and therefore, in order to measure small stability changes, stability is here defined as the percentage of particles not removed by centrifuging at 1000 *g* for 5 min; on this basis, the raw juices used in our studies had stabilities of between 50% and 90%. The standard procedure was adopted of always using 100 ml juice samples in the 400 ml centrifuge bottles of an M.S.E. centrifuge fitted with an automatic timing control. After centrifuging, the supernatant liquid was removed by pipette and a mean particle concentration determined by direct counting under a microscope; since no particle clusters but only single particles were seen in these supernatants, particle concentrations were determined more conveniently by the optical density method described in a previous paper[4]. Particle densities were then expressed as a percentage of the concentration present in the original raw juice. When studying the effect of an added reagent, in order to compensate for the volume of added solution, all juice samples were made up to the same volume (e.g. 110 ml) with distilled water, and 100 ml of this system taken for centrifuging.

Electrophoretic mobility determinations were made by the microelectrophoresis technique using a Mattson type single tube cell[9] of length 9·6 cm and internal diameter 1·0 mm fitted with platinum wire electrodes. The cell was mounted on the stage of a Baker microscope fitted with a fine focussing control, and an 8 mm objective and 25 × graduated eyepiece provided suitable magnification. Particle velocities were measured over a distance of 70μ at the stationary level which was located using the method of Henry[10]. The potential gradient was measured by means of a voltmeter placed between the tube electrodes, the potential difference thus recorded lying within 4% of that calculated from the current flowing and specific resistance of tube contents. The variation in mobility from particle to particle in a given suspension was small, giving an estimated error of not more than 5%.

Zeta potentials were calculated from mobilities using the Helmholtz-Smoluchowski equation for large solid particles,

$$\zeta = \frac{4\pi\eta}{D}\,u$$

in which u is the observed electrophoretic mobility in μ/sec. volt/cm and η and D respectively are the viscosity and dielectric constant within the double layer. These are taken to be the same as for water at the temperature of the tube contents, which was generally 27°C.

In the work described below the stability of various juice systems will be compared with certain physical properties of the particle surface which have been deduced from electrophoretic examination. It was desirable, therefore, to measure zeta potentials directly on the same systems used for stability determinations, but unfortunately this was not experimentally possible. The chief difficulty was that

[8] La Mer and Smellie: *J. Colloid Sci.*, 1956, **11**, 710.
[9] Mattson: *J. Phys. Chem.*, 1933, **37**, 223.
[10] *J. Chem. Soc.*, 1938, 997.

gassing at the electrodes occured at very low applied potentials, this presumably being due to both the high concentration of electrolyte and adsorption of material at the electrode surface. It was therefore not possible to use the high potential gradients at which particle velocities are large enough to be measured accurately and, furthermore, uncertainty in the values of η and D made the calculation of zeta potentials less accurate. It was necessary to dilute the juice samples before their electrophoretic examination and it is conceivable that some desorption of material from the particle surface may then have occurred.

In two juices, however, it has been possible to obtain approximate values for the zeta potential of particles in their undiluted environment, and in studying the effects of pH on zeta potential it was shown that the zeta potential-pH curves obtained with diluted and undiluted samples were not significantly different. The magnitude of the zeta potential at corresponding pH values did not differ by more than 2 mV while the isoelectric points did not differ by more than 0·2 pH unit ; it is concluded that in these cases desorption effects are small.

The zeta potentials quoted below were obtained using systems containing 5 ml of the juice in 100 ml of the required electrolyte (generally 0·01M KCl) : pH variation was obtained by the addition of HCl and KOH, the KCl concentration being reduced to maintain a constant total ionic strength of 0·01.

pH measurements were made using a Cambridge pH meter. Inorganic salts used in the other experiments described below were of "AnalaR" (analytical reagent) quality while the cetyltrimethylammonium bromide (CTAB) and sodium lauryl sulphate (SLS) detergents were twice recrystallised before use.

Results and Discussion

In figure 1 are shown the irreversible changes in stability which took place in four different cane juices as each was slowly heated to boiling and then boiled for 15 minutes. Three litres of each juice were heated in a beaker and the stabilities determined on cooled 100 ml aliquots which were withdrawn at the required temperature or after the required period of boiling. The first point on each curve was determined at room temperature and it is seen that the stabilities of the four raw juices range between 87% in juice (a) and 56% in juice (d). All stability curves are characterised by a sharp decrease in stability between 50 and 60°C and in each case this change was accompanied by the immediate appearance of flocs within the juice. As heating was continued the stability remained effectively unchanged up to 80°C, above which the four curves demonstrate wide variations in juice behaviour.

It is believed that the changes in stability are associated with the deposition of different layers of material at the particle surface. There are two ways in which such a stepwise deposition of material might be brought about by heating :

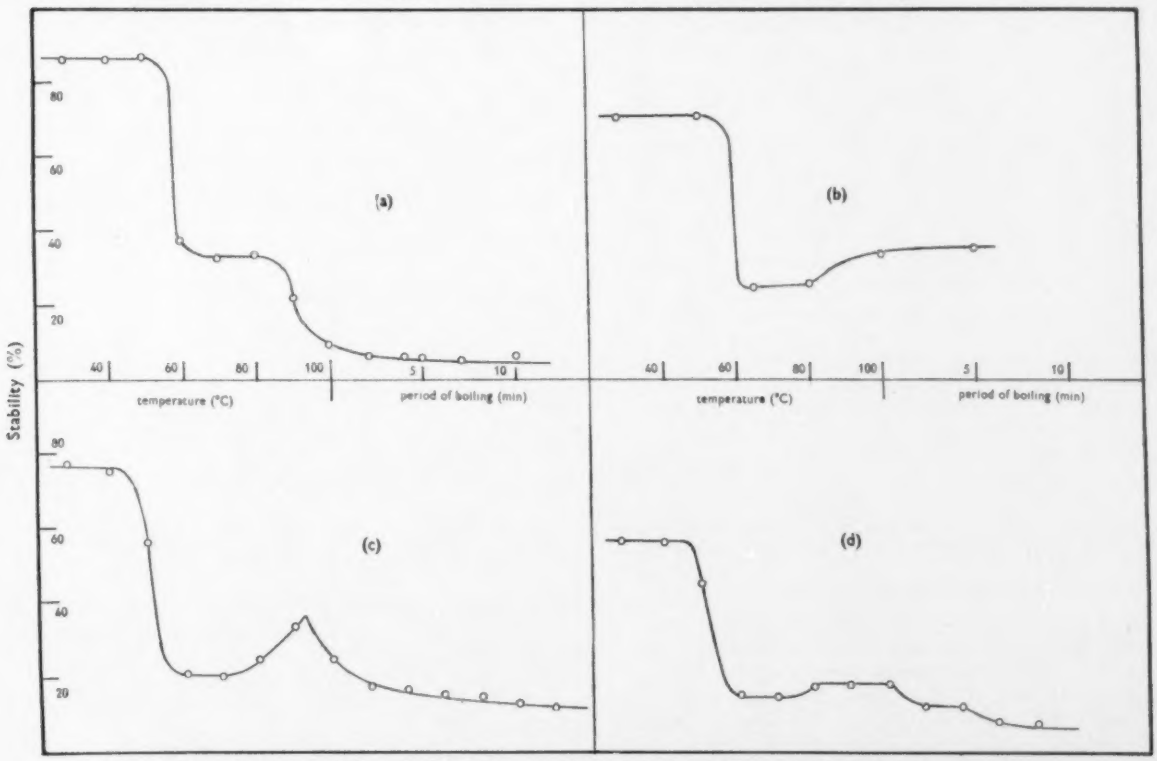

Fig. 1. The changes in stability of four juices as each is heated to boiling and then boiled for up to 10 min.

(i) the material is released from certain cane cell plastids which swell and possibly "burst" during heating.

(ii) the solubility of certain macromolecular material present in the continuous phase may be changed on heating so that a precipitation occurs.

Other studies provide an example of each case, viz. the gelatinization of cane starch granules[11, 12] around 60°C and the heat denaturation of protein[4, 13] around 90°C.

Microscopic examination of cane starch granules in their natural juice environment has shown that gelatinization temperatures for the four juices used here lie between 50° and 60°C ; it therefore appears possible that the stability changes in this temperature range may be attributed partly, if not wholly, to the effects of starch gelatinization. The stability changes above 60°C are very much more complex and only in one juice (a) could we possibly attribute the changes to protein denaturation alone. In (b), (c) and (d) the stability of the system increases above 70°C and in one case (b) remains at the higher level even after boiling for 5 min. There can be no doubt that protein denaturation does take place in all four juices and it is therefore concluded that in some cases the effects of this are modified, if not completely masked, by the deposition of other superimposed material.

In order to demonstrate that the above stability changes are related to changes in the nature of the particle surface, it is necessary to study the individual particle ; in the following section are presented the results of an electrophoretic examination.

(*to be continued*)

[11] BUCHANAN : *S. African Sugar J.*, 1958, **42**, 32.
[12] NICHOLSON AND HORSLEY : *I.S.J.*, 1958, **60**, 260.
[13] DEERR : *I.S.J.*, 1916, **18**, 558.

COMPARATIVE STEAM CONSUMPTION IN REMELTING SUGAR WITH WATER AND CLEAR JUICE

By S. P. SANYAL.

IN the modern process of manufacturing plantation white sugar, a considerable quantity of sugar has to be remelted. This may vary between 25 and 50% of all sugar produced, depending upon whether 'D' sugar or both 'C' and 'D' sugars are remelted in a four-massecuite system. But a great deal of confusion exists about the merits and demerits of the two different methods of remelting sugar, viz. with water and with clear juice. In a paper[1] by C. G. M. PERK, the subject is dealt with at some length and the use of water advocated instead of clear juice for a number of valid reasons, although the latter gives some steam economy.

In the present paper, the actual steam consumptions of the two processes have been calculated and it is shown that the extra advantage gained in melting with clear juice is so insignificant that there is no point of special favour in this case from the point of view of steam economy also. Hence melting with water is definitely the better way.

CALCULATIONS

Suppose 100 lb of sugar has to be melted to give a 60° Brix syrup. Since 60 lb of sugar requires 40 lb of water for melting, 100 lb of sugar requires $\frac{40 \times 100}{60}$ = 66·7 lb of water. Again, suppose 100 lb of sugar has to be melted with clear juice of 15° Brix. Let X lb of clear juice be required to melt 100 lb of sugar to make the melt 60° Brix, then the total weight of the melt is 100 + X lb. Since the melt is of 60° Brix,

100 lb of the melt contains 60 lb of solid.

100 + X lb of the melt contains $\frac{60(100 + X)}{100} = \frac{3(100 + X)}{5}$ lb solid.

This $\frac{3(100 + X)}{5}$ lb of solid consists of solid from X lb of clear juice + 100 lb of sugar.

Now, in 100 lb of clear juice there is 15 lb of solid

or in X lb of clear juice there is $\frac{15\ X}{100} = \frac{3X}{20}$ lb of solid.

Therefore the solids balance is :

$$\frac{3(100+X)}{5} = \frac{3X}{20} + 100 \text{ or } \frac{3\times100}{5} + \frac{3X}{5} = \frac{3X}{20} + 100$$

$$\text{or } 60 + \frac{3X}{5} = \frac{3X}{20} + 100 \text{ or } \frac{3X}{5} - \frac{3X}{20} = 100 - 60$$

$$\text{or } \frac{12X - 3\ X}{20} = 40 \text{ or } \frac{9X}{20} = 40$$

$$\text{or } X = \frac{40 \times 20}{9} = 88{\cdot}9 \text{ lb.}$$

Roughly 88·9 lb of clear juice of 15° Brix is required to melt 100 lb of sugar to make it 60° Brix.

STEAM CONSUMPTION PER 100 LB OF SUGAR MELTING

(1) *Melt Prepared with Water* : Suppose the melt of 60° Brix is converted to 100° Brix in pans by evaporation. Taking 1 lb of steam to evaporate 1 lb of water in pans, the steam consumption is 66·7 lb to evaporate 66·7 lb of water.

[1] *I.S.J.*, 1955, **57**, 254.

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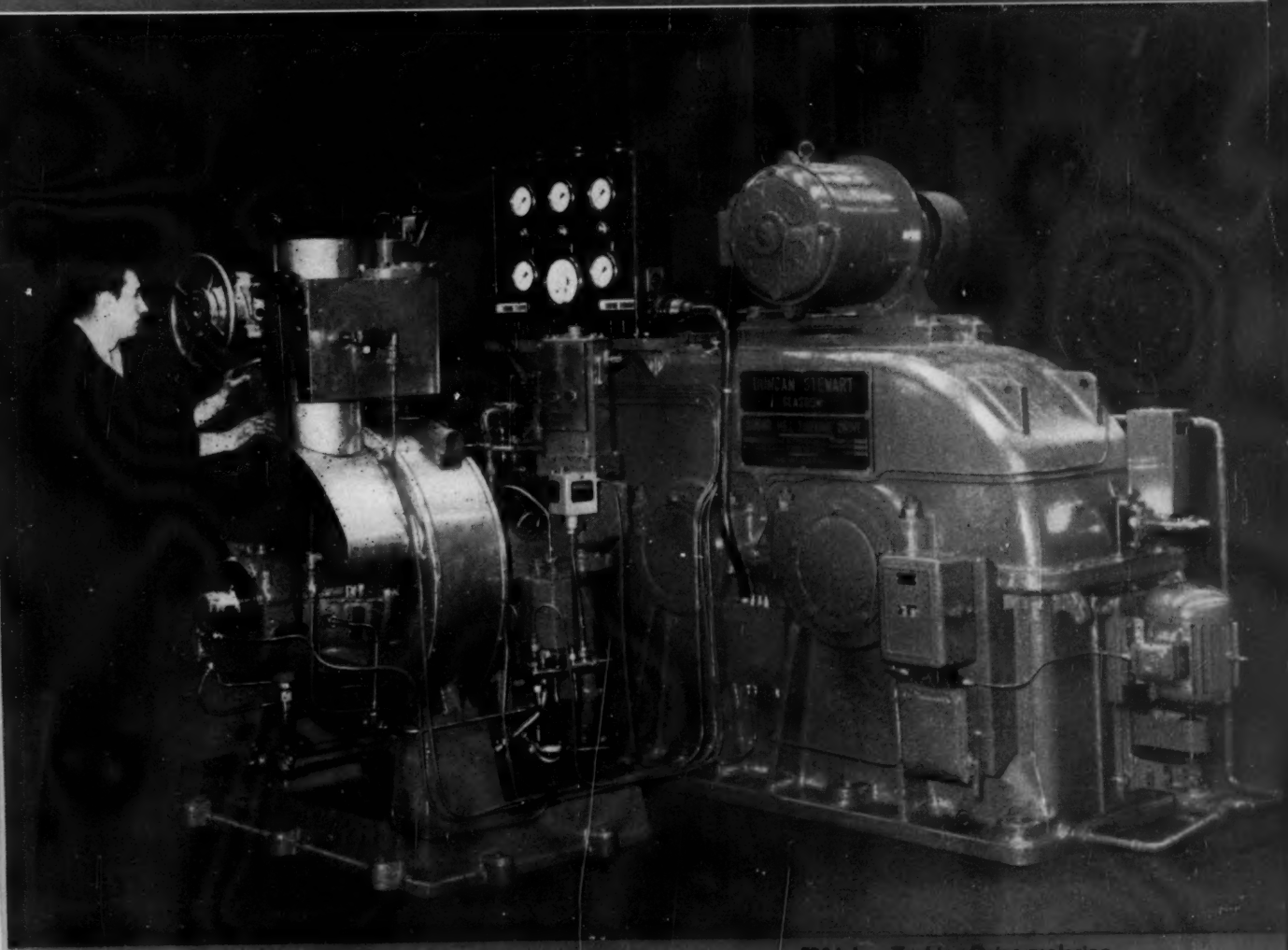

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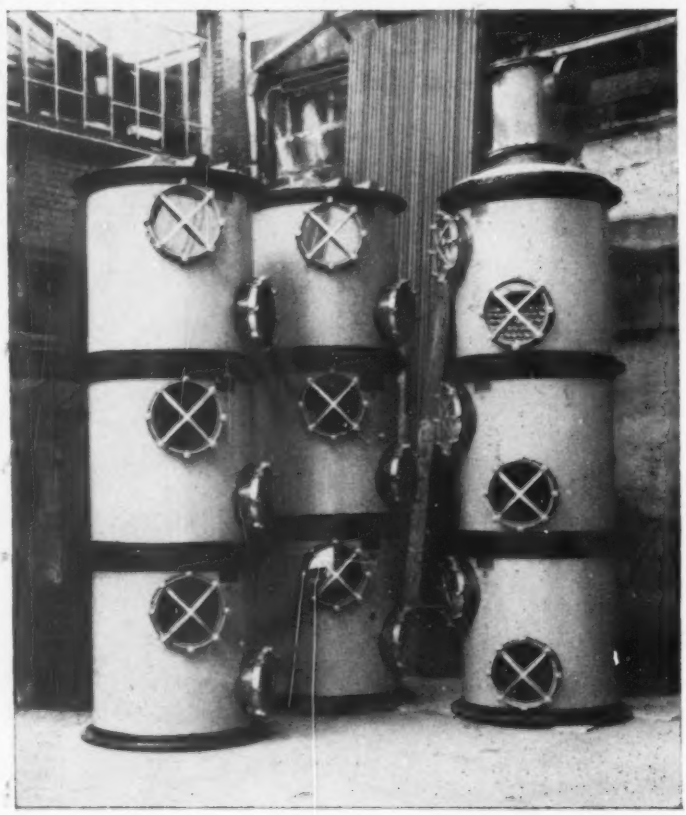

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To this is to be added the steam required to evaporate the water from 88·9 lb of clear juice, which could otherwise have been used for melting by raising the Brix from 15° to 60° in the evaporator and then evaporating the syrup obtained from 60° to 100° Brix in pans. To bring up the Brix of clear juice from 15° to 60° the water evaporation percent clear juice $= \frac{(60 - 15) \times 100}{60} = 75\%$

Therefore, for 88·9 lb of clear juice, the water evaporation is $\frac{88{\cdot}9 \times 75}{100} = 66{\cdot}7$ lb. The quantity of syrup obtained $= 88{\cdot}9 - 66{\cdot}7 = 22{\cdot}2$ lb of 60° Brix. As 100 lb of the syrup contains 40 lb of water, 22·2 lb of the syrup contains $\frac{40 \times 22{\cdot}2}{100} = 8{\cdot}9$ lb of water.

In the case of a quadruple effect, 1 lb of steam evaporates about 4 lb of water ; therefore the total steam required is the sum of steam required to evaporate 66·7 lb of water used for melting, plus steam required to evaporate 66·7 lb of water in 88·9 lb of clear juice in the evaporator, plus steam required to evaporate 8·9 lb of water in the syrup in the pans, i.e.:—

$$66{\cdot}7 + \frac{66{\cdot}7}{4} + 8{\cdot}9 = 66{\cdot}7 + 16{\cdot}7 + 8{\cdot}9 = 92{\cdot}3 \text{ lb} \quad \ldots.(a)$$

In the case of a triple effect, when 1 lb of steam evaporates about 3 lb of water, the total steam consumption is $66{\cdot}7 + \frac{66{\cdot}7}{3} + 8{\cdot}9 = 97{\cdot}8$ lb..... (b)

(2) *Melt Prepared with Clear Juice* : The total quantity of melt = weight of clear juice + weight of sugar = 88·9 + 100 = 188·9 lb of 60° Brix.

Now, 100 lb of melt contains 40 lb of water.

188·9 lb of melt contains $\frac{40 \times 188{\cdot}9}{100} = 75{\cdot}6$ lb of water.

When this melt is sent direct to the pan floor, this 75·6 lb of water requires 75·6 lb of steam in the pans for evaporation to 100° Brix.

In the case of melting with clear juice, 100 lb of sugar requires 75·6 lb of steam for evaporation.....(c)

Steam Consumption Percent Cane

The following calculations are made when only 'D' sugar is melted in a four massecuite system:

Let us assume, for 100 tons of cane crushed, that clear juice = 100 tons ; Brix of clear juice = 15° ; purity of clear juice = 85 ; purity of final molasses = 33 ; purity of D-massecuite = 60 ; purity of double cured D-sugar = 99 ; then total brix imported = 15 tons.

Quantity of Double Cured D-Sugar

The following calculations are made on dry substance basis by weight :—100 dry substance in clear juice contains (100–85) = 15 non-sugar, or 15 tons of dry substance in clear juice contains $\frac{15 \times 15}{100} =$ 2·25 tons non-sugar. Again, (100–33) or 67 parts of non-sugar produces 100 parts of molasses or 2·25 tons non-sugar produces $\frac{100 \times 2{\cdot}25}{67} = 3{\cdot}357$ tons molasses.

Let X be the percent of molasses in D-massecuite.

Then $100 \times 60 = (100 - X) \times 99 + 33X$

or $6000 = 9900 - 99X + 33X$ or $99X - 33X = 9900 - 6000$

or $66X = 3900$ or $X = \frac{3900}{66} = 59{\cdot}1$

Therefore, there is 59·1 parts molasses in 100 parts of D-massecuite or there is 3·357 tons molasses in $\frac{100 \times 3{\cdot}357}{59{\cdot}1} = 5{\cdot}68$ tons of D-massecuite.

Then, the quantity of D-massecuite produced = 5·68 tons.

Therefore, the quantity of D-aftercured sugar = 5·68 — 3·36 = 2·32 tons.

A—Melting with Water : We have seen that in case of melting with water in a factory having a quadruple effect evaporator, 100 lb sugar requires 92·3 lb of total steam consumption,

or 1 lb sugar requires $\frac{92{\cdot}3}{100}$ lb of total steam consumption,

or 1 ton sugar requires $\frac{92{\cdot}3}{100}$ tons of total steam consumption,

or 2·32 tons sugar requires $\frac{92{\cdot}3 \times 2{\cdot}32}{100} = 2{\cdot}14$ tons steam consumption.

Hence steam consumption % cane is 2·14 in case of melting with water. Calculations for factories using triple effect evaporator can be done similarly.

B—Melting with Clear Juice : We have seen that in case of melting with clear juice,

100 lb of sugar requires 75·6 lb of steam consumption

or 1 lb " " $\frac{75{\cdot}6}{100}$ " "

or 1 ton " " $\frac{75{\cdot}6}{100}$ tons " "

or 2·32 tons " $\frac{75{\cdot}6 \times 2{\cdot}32}{100} = 1{\cdot}75$ tons "

Therefore, the steam consumption percent cane is 1·75.

Hence, the extra steam consumption in case of melting with water is 2·14 — 1·75 = 0·39 percent cane only.

For a saving of only 0·39% of steam on cane it is not desirable to melt the sugar in clear juice, firstly for the reason that the entire pipe line conveying the clear juice is found always full of deteriorated juice, especially when the pipe line is a long one and the melting stops for any reason. The second objection is that when the melt is mixed with the bulk of clear juice and sent to evaporator, there is bound to be some unknown loss, because the melt is always acidic and the boiling temperature in the first body of a quadruple is quite high.

In some factories following a four-massecuite system, both C & D after-cured sugars are melted. In this case the steam consumption is nearly double.

New Mill for Peru. ANON. *Sugar y Azúcar*, 1958, **53**, (4), 35.—A Squier 15-roll mill tandem installed at Sociedad Agricola Pucala Ltda. and planned to operate from autumn of last year has a rated daily capacity of 5000 tons cane of 15% fibre content. The 36 × 78 in rolls have 1¼-inch grooving (the crusher 2½-inch), the top and cane rolls have diagonal cross grooving and the cane rolls Messchaert grooving. The rolls can be removed without disturbing the intermediate carriers, and the turnplate can be inspected and removed without dismantling any other parts. Each mill is driven individually by a 750 h.p. steam turbine.

* * *

Effect of Temperature on the Last Phase of Low Grade Massecuite Maturing. A. MIRCEV, A. FRIMLOVA and M. FRIML. *Listy Cukr.*, 1958, **74**, 81–86.—Laboratory crystallization tests at 30, 40 and 50°C have confirmed that at a constant non-sugars : water ratio the saturation coefficient is independent of temperature and is expressed as a linear function by the following formula :—

$$K_s = 0{\cdot}3666 \text{ non-sugars/water} + 0{\cdot}5233.$$

The significance of the non-sugars : water ratio at different temperatures for the calculation of the theoretical crystallization and for comparison with the actual results is discussed. The processing of low-grade massecuites (2nd product) is also discussed on the basis of the crystallization curves produced and of calculations for the determination of the supersaturation coefficient.

* * *

The Sugar Industries of Mauritius, Réunion and South Africa. H. W. KERR. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 27–38.—All phases of cane sugar production in the three territories are briefly described, with comparisons between themselves and also with Queensland practice in some cases.

* * *

Review of the Research Work of Dr. K. J. Bullock. M. SHAW. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 39–44.—A summarised account is given of the work reported in the thesis presented by Dr. K. J. BULLOCK to the University of Queensland and entitled "An investigation into the crushing and physical properties of sugar cane and bagasse".

* * *

Bulk Density as a Measure of the Fineness of Preparation of Cane. C. R. MURRY. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 45–51.—Experiments were carried out in the University of Queensland experimental mill using five work openings, two speeds and five preparations. Cane was prepared in a hammer mill and the bulk density of the whole sample to be crushed (9 lb) was measured by placing in a pre-compressor under 7½ p.s.i. and measuring the height of the block produced, the area being known. The sample was milled and the extraction determined. Bulk density serves as a satisfactory practical measure of the fineness of preparation, remembering that, contrary to the normal trend at higher compression ratios, at fairly small compression ratios (say 2 to 1½ in the experimental mill) the extraction is independent of the preparation, while for very small ratios (less than 1½) extraction falls as the fineness of preparation is increased. When considering roll load and torque, the bulk density serves as some measure of the fineness of preparation. However, at high compression ratios the torque and roll load appear to become independent of the preparation.

* * *

Fibre Properties as Related to Milling Quality of Cane. B. D. SOCKHILL. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 53–58.—A study of the basic structure of the sugar cane and of the fibre properties was made at the Sugar Research Institute. Three varieties were studied, viz. Badila, Q.30 and Pindar. The characteristic showing the greatest difference between these was the tensile strength of the individual fibre (vascular) bundles, which should be high for efficient milling. The number of vascular bundles is also to be considered ; but although a moderate rind thickness is probably desirable, it is pointed out that the rind and node tissue hold sugar which is difficult to extract, so that the proportions of these sections should not be high. Thus the ideal cane for milling purposes is one of moderate fibre content with very strong vascular bundles.

* * *

A New Design of Crushing Mill for the Queensland Sugar Industry. S. G. CLARKE. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 59–63.—A new three-roller mill is described and illustrated. The 37-inch dia. rollers, 6 ft 6 in long, have a maximum speed of 47·5 f.p.m. and are driven from the top roller by a square tail bar and box coupling powered by a 1200 h.p. steam turbine. The centres of the rollers form an isosceles triangle with an included angle of 74°. The top roll is geared to the side rolls by partially enclosed pinions running in an oil bath. The journals are carried in water-cooled mechanically-lubricated

brass bearings, the top and side bearings being interchangeable. Feed roll setting adjustment is by means of wedges actuated by screws accessible from the outside of the feed roll cap. The delivery roll is supported on self-aligning hydraulic cylinders, self-sealing couplings being included in the hydraulic oil line to allow the system to be disconnected without fear of air intake. Packers bearing on abutments machined onto the cheek and hydraulic cylinder maintain the roll setting, quick adjustment necessitating the removal of only one small retainer plate at each packer. The trash bar is adjusted by means of a new leverage system, depicted diagrammatically, which allows a greater thrust on the trash bar than do conventional systems. The apron scraper plate on the delivery roller is built in with the intermediate carrier to allow the carrier to be lifted clear of the mill as a complete unit. Through bolts are replaced by cap bolts and pins, the side cap pins being free in their holes for ease of insertion.

* * *

Roller Surface and the Efficient Operation of Mills. C. J. ALLAN. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 65–73.—The significance of roller surface preparation and condition in cane milling and mill slip are discussed and the main circumferential grooving requirements of the three rollers considered. Chipping or arcing is recommended to increase the angle of grip and facilitate roughening of the roller. The various forms of nicks are described and arcing with a carbon rod suggested (except in the case of dirty top rollers). Mill openings are discussed and a system of controlling the openings described. Current juice grooves are considered inadequate, and experiments with forms other than the Messchaert grooves are recommended. The coordination of good mill grooving, surface preparation, and mill ratio is emphasized for long-term mill efficiency, even where reduced extraction is the result.

* * *

Movement of Bagasse in Long Chutes. C. R. MURRY and R. HUTCHINSON. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 75–81.—An equation has been developed in which the ratio of the pressures at the entry and exit of a bagasse feed chute are expressed as an exponential function of the ratio of the length of the chute to its depth, thus :

$$\frac{p^1}{p^2} = e^{2\mu k \frac{L}{B}}$$

where p^1 and p^2 are the pressure built up by the pressure feeder rolls at the entry and the pressure required to feed the mill respectively, μ is the coefficient of friction of bagasse, k is the transverse "pressure" due to longitudinal "pressure" ÷ longitudinal "pressure", and L and B are chute length and depth respectively. The theory of this equation was tested with a specially constructed apparatus using fine bagasse from fresh cane from which about 45% of the juice had been expressed. One set of results is plotted on a graph and shows that the theory is sound within the experimental error under the given conditions. The effect of such variables as type of material (bagasse or cane), preparation, length of wads of material, and back pressure, on the value of μk was tested. The wad length had little effect, while preparation and type of material had significant effects. Wet material and fine preparation gave lower values. It is recommended that "high" closed feed chutes should be at least 12 ft 6 in long, that a cane column of at least 10 ft should be kept available, and that the chutes should be as deep as possible. Pressure feeder chutes should be as short and deep as is practicable, while the pressure required to feed the mill should be as low as possible.

* * *

Milling and Mill Feeding. H. D. DONNELLY. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 83–91.—The problems of mill feeding are first discussed. Gravity feed was introduced at Pioneer factory, the feed chute for No. 1 mill being 13 ft long at an angle of 65° and that for No. 4 mill being 14 ft long at an angle of 60°. A graph shows the feed pressure for various angles and lengths of feed mats. The feed plate should meet the feed rollers at an angle of at least 30° to the vertical central line. The condition of roller surfaces is discussed and the significance of a "dirty" top roller, whereby the scraper plate is lifted and the grooves are packed with bagasse, is considered. In the author's opinion the moisture in bagasse can be kept to a minimum by running the top roller thus, and most successfully where the grooves are of 35° or less and the tops and sides of the grooving are kept in a very rough state. The top roller of a new 5th mill installed in 1956 has always been run "dirty", giving average bagasse moisture contents of 41·7% and 42·3% in 1956 and 1957 respectively. The ratio of feed to delivery openings is discussed and the need to vary this according to mat thickness and condition of the material is emphasized. The ratios used at Pioneer of at least 3 : 1, although high, give satisfactory results when used in conjunction with a "dirty" top roller. It is suggested that the mat thickness should be no greater than the radius of the top roller, and the set feed opening should not exceed 0·125 times the nominal dia. of the rollers. The speed of the intermediate carriers should be at least equal to the surface speed of the rollers.

* * *

The Fairymead Cane Cleaner. R. F. BEALE and L. B. PASHLEY. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 93–101.—The cane cleaning plant at Fairymead comprises two carriers on the second of which the cane is washed by water sprays and cascades, three pairs of Olsen rolls, and a trash elevator, which also acts as a drainage tray. The cane is conveyed on the 9 ft steel slat carrier to a carding drum, which teases the cane and shakes out loose trash and dirt ; thence it drops to the second carrier, the high speed (156 f.p.m.) and great width (11 ft) of which ensure a thin mat of cane, thereby allowing

the best cleaning action by the water. The spray water is cascaded back onto the cane by the carrier boards. The trash passes via the drag carrier trash elevator to trucks, while the cane passes down a chute over the Olsen rolls to the main carrier. The 8000 roll discs are replaced every season. Water consumption is 26,000 gallons per hour, although 40,000 gallons is considered the minimum requirement for satisfactory operation. The plant is compared with a typical Hawaiian unit. Tests have shown that trash removal efficiency is poor ; it is assumed that, as inspection has shown that most of the earthy materials are removed, the trash on the body of the cane stalks is not removed. However, it is hoped to increase the efficiency by increasing the water supply and thereby raising the pressure of the jets. The lumpy feed entering the second carrier is considered the greatest single factor affecting the performance, and, as this is due to the increased crushing rates, an improved carding device is deemed necessary.

* * *

Boiler and Turbine Operation. D. S. SHANN. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 109–114.—Wastage in turbines is due to corrosion and erosion ; that it is less in mill drive units than in power generators is due (i) to the fact that the former are generally run at a rate lower than their capacity so that the unit is throttled, which increases the pressure, so converting saturated steam to superheated ; the consequent absence of condensation means that corrosive substances pass harmlessly through the machine either as gases or as dry solids ; and (ii) the running at lower than rated capacity also means that steam velocity is comparatively low, which reduced erosion of the turbine blades. The extent of wastage in saturated steam tubrines depends to a large extent on the steam quality and the effect on this of variation in boiler operation has been examined using a throttling calorimeter connected to a vacuum pump on its low pressure side (so as to measure qualities down to 92% dry saturated). With a new Babcock & Wilcox boiler at Racecourse Mill it was found that, at high evaporation rates, the drum water height between the gauge limits has little detrimental effect on quality where feed water is uncontaminated. It is essential that a safe pH (8·5–10·5) be maintained in the boilers, with immediate attention should any drop occur.

* * *

Sugar Drying Tests at Mossman. J. P. KOMEN. *Proc. 25th Conf. Queensland Soc. Sugar Tech.*, 1958, 151–154.—Quantity, temperature and moisture content of sugar and air entering and leaving the dryer at Mossman were measured in a series of tests and the "unaccomplished moisture change" (U.M.C.)—residual moisture % initial moisture—calculated for different air/water ratios (x) using A and B sugars. Close relationships were found, viz.:—

$$\text{U.M.C.} = e^{-0.0208}\, x \text{ , for } A \text{ sugar, and}$$
$$\text{U.M.C.} = e^{-0.0197}\, x \text{ for } B \text{ sugar.}$$

This does not, in itself, offer a basis for automatic control, however, since, for example, there is no obvious relationship between "stickiness" of the sugar and other variables.

* * *

Degree of Impurities Elimination during Clarification as Determined at Mulgrave Mill. F. BREEN. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 155–157.—The sucrose and total solids in mixed juice, raw sugar and final molasses were determined and the amount of impurities calculated for before and after clarification. The extent of elimination, expressed as a percentage, is recorded for fortnightly intervals during the 1957 crop and varies from below 10% to about 27%. The average during the 1957 season was 21% compared with 18% in 1956 and 28% in 1955. Thus it corresponds fairly well with the 25% assumed in the c.c.s. formula, but can go much lower under unfavourable conditions.

* * *

Low Grade Crystallization and Sugar Recovery. D. H. FOSTER, B. D. SOCKHILL and E. T. RELF. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 179–188.—Final massecuites from various mills were maintained at constant temperature in an experimental model crystallizer of 5 gallons capacity and the molasses purity determined at intervals until crystallization equilibrium was reached. The "pan supersaturation" was then calculated. The massecuites were then cooled through 35°F and crystallization continued, the viscosity and molasses purity being measured again at intervals. Finally, the massecuites were re-heated, the molasses purity and viscosity again being determined. From the results obtained it is found that final massecuites may be discharged at supersaturation up to 1·2 without inducing fine grain formation, provided that they are fully stirred in the crystallizer and not chilled with cold residual massecuite from a previous charge. Cooling should be as rapid as possible since crystallization causes the saturation temperature to fall by 4–8°F per hour compared with 2–3°F generally achieved. Provided the massecuite is allowed to come to equilibrium, true purity is reduced by about 1 unit per 7°F of cooling. Molasses viscosity and not crystallization rate fixes the exhaustion limit. A suggestion as a criterion of good exhaustion is the purity of molasses which is saturated and of 1000 poises viscosity. The saturation temperature of exhausted molasses is very close to the temperature to which it has been cooled, consequently reheating will generally produce unsaturated molasses. Hence, maximum exhaustion is obtained by cooling as far as the strength of the crystallizer will allow, followed by as rapid reheating and centrifugalling as possible to minimize re-solution.

* * *

The South Johnstone Method of Reheating Final Massecuite. G. E. WADDELL. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 195–197.—Final massecuite is cooled in two Werkspoor crystallizers in series, the second having 60 sq. ft. of reheating

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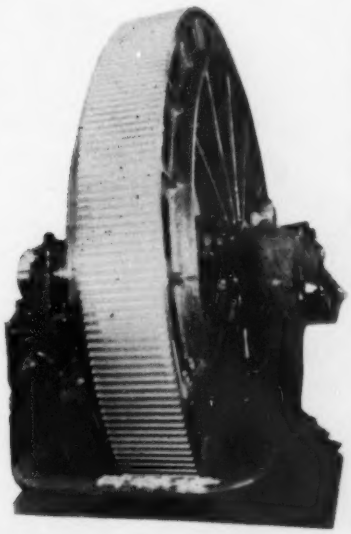

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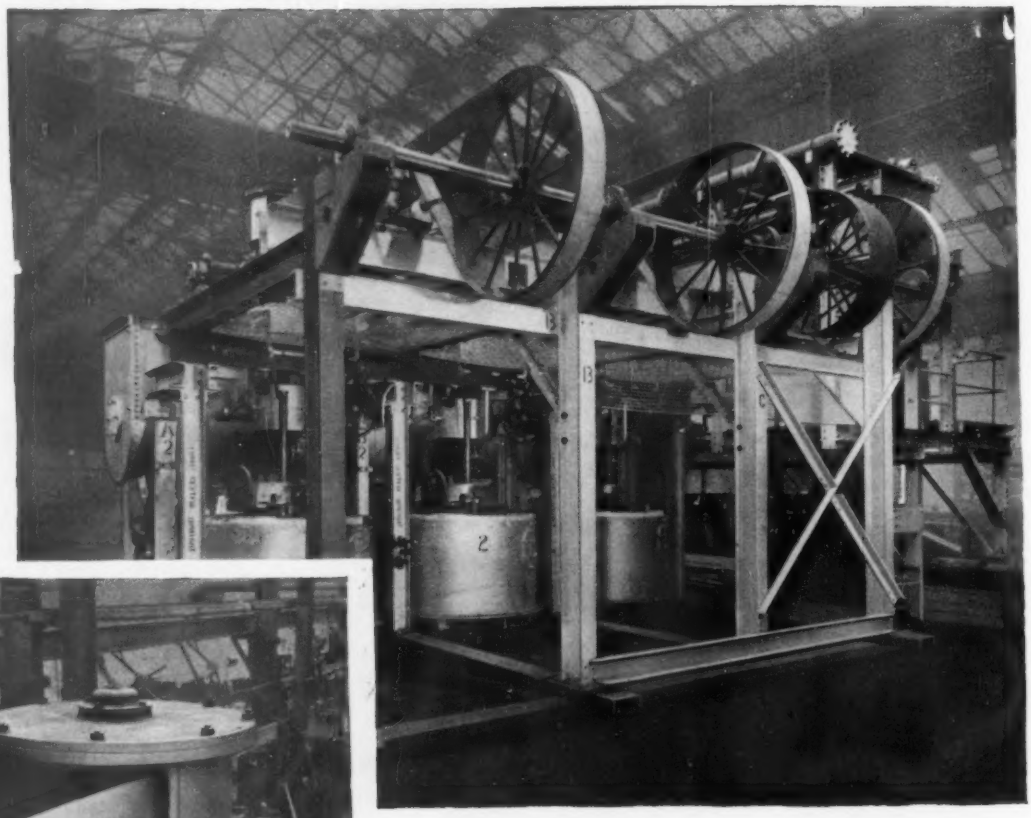

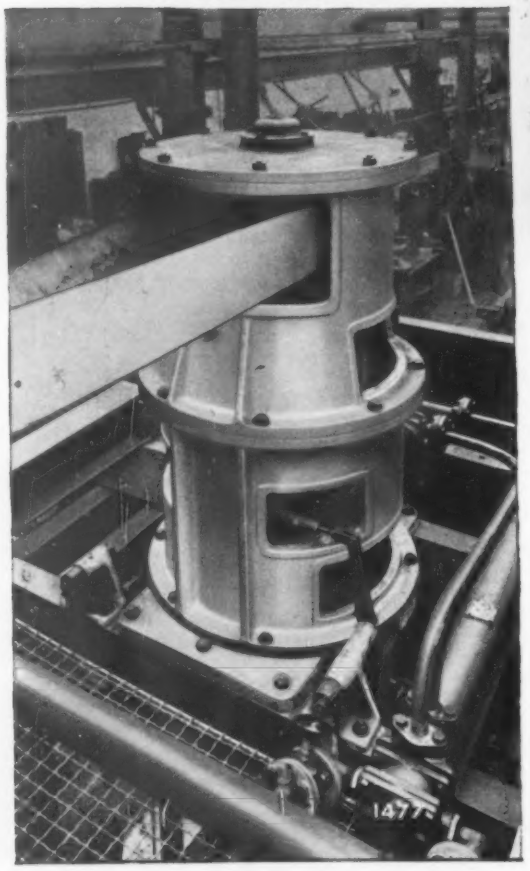

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surface. With an average Brix of 98, difficulty was experienced with pumping when the temperature dropped below 120°F so that more reheating was required. The second crystallizer supplies an 8 inch pump through 4 feet of 8-inch piping and thence the massecuite travels to the back mixer through 54½ feet of 7½-inch piping. Copper tubing of $\frac{5}{16}$ in dia. was wound around these pipes, insulated, and fed with high pressure steam. The temperature was measured at two points along the longer pipe by pneumatic control instruments which governed the steam feed to the copper tubing. It was found that the tubing fitted (920 ft) was inadequate, and also that there was considerable skin overheating ; consequently for the 1958 season, boxes containing baffles were to be installed at 18 ft intervals along the pipe to provide adequate mixing, and the tubing length was to be increased by 67%.

* * *

Heating Surface Arrangement and Circulation in Vacuum Pans. G. H. JENKINS. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 199–207.—It is shown, for heavy massecuites under the conditions obtaining at the end of a strike, the flow of massecuite through the tubes and downtake is well within the range of viscous flow ; hence friction head and rate of flow are given by POISEUILLE's equation. A method of calculating the dimensions and arrangement of heating surface is given for calandria pans, based on the proviso that resistance to flow through the downtake should be very small compared with resistance to flow through the tubes. Conditions for minimum resistance to flow through the tubes are also discussed, leading to a recommendation that calandria tubes should be as many and as short as possible and closely spaced.

* * *

Technological Scheme for Processing Raw Cane Sugar. E. D. ZINCHENKO. *Sakhar. Prom.*, 1958, (4), 15–17.—The refining technique at L'gov, used since 1957, is to melt non-affined raws at 77–78°C, clarify by carbonatation and sulphitation, and recover the sugar in a three-boiling system. Final molasses purity is 55·0 and the sugar quality conforms to the required standard.

* * *

Calculation of Massecuite Quantities in the Sugar House. H. SPEYERER. *Zucker*, 1958, **12**, 202–213, 238–248, 264–272.—Equations are developed for two boiling schemes for raw sugar, one for white sugar and four for refining, on the basis of dry solids and sucrose balances previously discussed[1]. These enable calculation of the individual and total massecuite quantities and yields by insertion of the purities concerned. Sample calculations are given for each of the schemes, with an indication of the likely error.

* * *

Clarification Difficulties in Puerto Rico Mills. L. A. SOSA. *Sugar J.* (La.), 1958, **20**, (12), 61–62.—Clarification difficulties encountered in Puerto Rico over the last 30 years are discussed and the main causes considered to be the POJ cane varieties, mechanized harvesting, and overloading clarifier capacity by high mill extractions and grinding rates.

* * *

Clarification of Cane Juice in the Sugar Industry. M. M. DE HOLLANDA F. *Brasil Açuc.*, 1958, **51**, (5), 31–32.—Clarification is briefly discussed and the importance of adequate liming (to pH 7·4), sufficient P_2O_5 present, and a retention time of no more than 4 hours is emphasized.

* * *

Boiling of Final Massecuite. P. V. GOLOVIN. *Trudy Kiev. Tekhnol. Inst. Pishchevoi Prom.*, 1956, **16**, 3–7 ; through *S.I.A.*, 1958, **20**, Abs. 346.—A new proposed method of boiling consists in boiling green syrup to 92–92·5% dry solids, cooling it to 70–72°C by auto-evaporation under vacuum during 10–15 minutes, discharging the massecuite to mixers where it is cooled to 37–35°C or even 30–27°C, and then reheating to 40–42°C before centrifuging. Sugar losses can be reduced to 0·09–0·14% on beet. Factory results are reported and calculations of yields are given.

* * *

Temperature Conditions of Final Massecuite Crystallization. M. I. DAISHEV. *Sakhar. Prom.*, 1958, (5), 23–25.—Graphs of saturated final molasses Brix *vs.* purity are plotted for temperatures at 5° interval between 30°C and 60°C for molasses from 3 different factories. The use of these to determine optimal temperature conditions for final massecuite crystallization is discussed.

* * *

Experience in Production Automation at Kozhan Sugar Factory. M. L. ZELENYUK. *Sakhar. Prom.*, 1958, (5), 46–48.—Diagrams are given of 3 automatic systems (1) for boiler steam pressure indication, (2) for level control in a water tank, and (3) for steam regulator operation.

* * *

Asbestos Cement Shoes for Friction Clutch Blocks. A. F. BEREZOVSKII. *Sakhar. Prom.*, 1958, (5), 50–51.—Asbestos cement for shoes on PS, PM and other types of centrifugals has proved satisfactory and is recommended in place of other materials already used. The shoes last 25–30 days on raffinade and 1st product centrifugals, and at least 60 on 2nd and 3rd product centrifugals, compared with 5–7 days for other materials.

* * *

From Factory Practices. (Cleaning 1st Evaporator Effects and a Universal Foundation for Centrifugal Pumps and Electric Motors.) L. I. SHAPIRO. *Sakhar. Prom.*, 1958, (5), 51–54.—A 10 cm layer of turpentine on water is used to remove oily deposit from the steam-side of the 1st effect tubes. The steam chest is half-filled with water, fed through the condensate exit port, and a quantity of turpentine added (200 kg for 1000 sq. m. heating surface). The water level is then raised to the top of the chest, then lowered

[1] *I.S.J.*, 1956, **58**, 339.

almost to the bottom, so that the turpentine layer cleans as it rises and falls. The operation is repeated 10–15 times and has proved successful in a number of factories. The universal foundation consists of slotted girders ; the pump or motor bases can be bolted to these irrespective of differences in the intervals between the fixing bolts. The foundations are made in three sizes.

* * *

Development and Status of Centrifugal Technology. J. JASKOLSKI. *Zeitsch. Zuckerind.*, 1958, **83**, 273–278.—The progress in centrifugal technology up to the latest fully automatic machine is reviewed and the advantages and disadvantages of the continuous and discontinuous centrifugals are discussed. The basic features of construction of each type of machine are described.

* * *

New Bactericide Inactivates Invertase. J. W. APPLING. *Sugar y Azúcar*, 1958, **53**, (6), 23–25.—An organic sulphur bactericide (A) containing 20% disodium cyanodithioimidocarbonate and 7·5% ethylenediamine was found to control slime accumulation (and thus invertase formation) on factory equipment, especially mills, when added at 10 p.p.m. to imbibition juice. Laboratory tests showed that 10 p.p.m. of this or another bactericide (B), containing 13·3% disodium cyanodithioimidocarbonate, 4·7% ethylenediamine and 18·0% potassium N-methyldithiocarbamate, completely inactivated invertase in sucrose solution (1 mg purified invertase per 100 ml) for at least 30 min, while 5 p.p.m. of (B) caused a significant drop in sucrose loss due to invertase for 30 min. Neither bagasse nor any of the organic constituents of sugar juice inhibit the bactericide, and analysis for sulphide, cyanide, and thiocyanate showed that the bactericides were destroyed during clarification and evaporation.

* * *

Diminution of Ash in Sugars. J. M. LÓPEZ-OÑA. *Mem. XXX Conf. Asoc. Técn. Azuc. Cuba*, 1956, 107–109.—Reduction of ash in refined sugar was reduced from 0·045% to an average of 0·007% by replacing the lime used in refining by caustic soda and by using carbon alone instead of with "Sucro-Blanc". Reduction of ash in raws may be achieved, according to laboratory experiments, by cold liming of raw juice to pH 7·2–7·4, followed by treatment with sufficient NaOH to give a clear juice of pH 6·9–7·2. This is expected to result also in less evaporator scale formation, with consequent savings.

* * *

Sucrose Losses by Exothermic Reaction in Final Molasses. G. T. REICH. *Mem. XXX Conf. Asoc. Técn. Azuc. Cuba*, 1956, 115–128.—The deterioration of final molasses in storage is considered, with especial reference to the case at Central Fajardo in Puerto Rico which the author investigated on behalf of the insurance company. He concludes that no exothermic reaction can be induced with normal molasses and that no microbiological action was the cause of the deterioration. The effects were a function of the individual molasses, possibly associated with its amino-acid content among the other impurities present. No carbonization took place, the insoluble solid product being a resinous material, not attacked by acid.

* * *

New Economic Possibilities of Mud Exhaustion and Elimination of the Filtration Department. J. M. SALINAS and M. GONZÁLEZ GARCÍA. *Mem. XXX Conf. Asoc. Técn. Azuc. Cuba*, 1956, 129–133.—A process is described whereby cachaza (defecation mud) is washed in counter current in three stages with 3 volumes per stage, its pol being reduced thereby, from e.g. 12·0% to 0·33%. The equipment comprises three tanks fitted with stirrers and the appropriate piping ; three settlers or small clarifiers would be better.

* * *

Graining with Molasses by Full Pan Seeding. G. ALEMÁN HIDALGO. *Mem. XXX Conf. Asoc. Técn. Azuc. Cuba*, 1956, 135–152.—The two-massecuite system, using full pan seeding and graining on molasses, is fully described, and criticisms that grain quality would be reduced are refuted both on theoretical grounds and on the basis of practical experience. The techniques of seeding the B-pan with powdered sugar, and of controlling pan boiling with a super-saturation meter of Fischer & Porter design are described. When syrup purity is too high to give satisfactory exhaustion of final molasses, some A-molasses is returned to adjust it accordingly ; this does not cause any bad effects as the quantity is small. When the syrup purity is low the "2½-massecuite system" is used. Here the C-strike is made using a mixture of A-molasses and B-molasses to give the required purity for satisfactory exhaustion and purging ; the use of A-molasses means that less is available for use in B-strikes. Massecuite, sugar and molasses quantities are calculated and tabulated for 2-, 3- and 4-massecuite systems graining on syrup and for the 2-massecuite system graining on molasses ; it is seen that the last can increase the pan capacity by 20%.

* * *

Two-Massecuite System with full Molasses Seeding and Partial Cooling of the A-Molasses. G. FUNDORA. *Mem. XXX. Conf. Asoc. Técn. Azuc. Cuba*, 1956, 157–167.—A description is given of the process whereby A-massecuite is of 83–85 purity and is partially cooled and reheated before purging. Grain is developed by seeding, with icing sugar, A-molasses obtained by spinning before cooling. The B-massecuite is built up on this grain, using molasses from the cooled and reheated A-strike. The syrup is adjusted to 83–85 purity by returning A-molasses, if necessary. The system is compared with the 3-massecuite system by calculation of the solids balance ; the new system involves 27·12% less quantity of massecuites, and, in addition, the raw sugar produced is found to be easier to refine, requiring less carbon.

Campaign Observations on the BMA Tower. W. WERNER. *Zeitsch. Zuckerind.*, 1958, **83,** 224–227.—Tests were made at Gronau factory in 1957 with a BMA tower diffuser to determine the purity, weight, sugar and non-sugars content of the juice at seven sampling points during diffusion. The purity of the juices in the upper part of the tower (up to 5 m from the top) was below 70%, and was about 80% only at about 10 m from the top. The purity at 13 m (85·5%) was still considerably below that of the raw juice. Thus the conditions in the tower, where fresh water and press water are used, are similar to those where fresh water only is used. Calculations of the amount of raw juice at the various sampling points showed that the pressing effect in the upper part of the diffuser was greater than in the lower part of the BMA tower. The final draught was 122%. Full details of the raw juice and press water are tabulated. While the sugar content increased from 2·2% at point No. 1 to 20·5 at point No. 5, the ash only increased from 14·5% to 37·1%. However, the latter underwent a greater increase up to point No. 7 (three-quarters of the way down the diffuser), when it was 53·2% of the raw juice ash. Treatment with SO_2 of the condensate used as fresh water was tested during three campaigns. While this was effective in reducing the infection during the first two campaigns, during November and December of the last campaign no success was achieved and considerable amounts of formalin had to be used to prevent a sharp drop in the pH in the tower. The amount of SO_2 used is apparently dependent on the ripeness of the beets, and it is considered that a reduction in the infection would be effected by improvements in beet washing and by chlorination of the wash water. Under these circumstances, the addition of SO_2 would be beneficial.

* * *

Experiments on Beet Lifters. H. GÖHLICH and H. VON HÜLST. *Zucker*, 1958, **11,** 154–156.—The usual types of beet lifter cause root breakage by their shearing force[1]. A rotary lifter, with a vertical pulling action, is described. It has given favourable results during tests, though further investigations are needed for confirmation.

* * *

Automatic Control of Second Saturation in Sugar Production using a pH Meter and a Flame Photometer. H. ZAORSKA. *Chem. Tech.* (Berlin), 1958, **10,** 213–215 ; through *J. Sci. Food Agric. Abstr.*, 1958, **9,** ii 183.—An apparatus for automatic control of the second saturation of sugar juice is described. A differential pH meter is used, and addition of NaOH or HCl is controlled electronically. A flame photometer regulates the rate of addition so that the pH value of the juice after second saturation corresponds to a minimum Ca concentration.

* * *

The Causes of a High Residual Lime Content in Thin Juices. G. BERNSEE. *Zeitsch. Zuckerind.*, 1958, **83,** 228–231.—Investigations were made into the high lime salts content of clarified juices at Neuoffstein factory. This was about 0·080% CaO/100°Bx and was not, it was found, due to the properties of the processed beet. Factory raw juice was used in the laboratory tests, and graphs are reproduced. The various explanations offered in the literature for the high content are discussed and a graph is drawn of the effect of defecation alkalinity and the liming method on the thin juice lime content. The relationship between main liming alkalinity and the thin juice lime content where muds or carbonatation juice are returned is discussed and it is shown that an alkalinity of 1·15% CaO on juice corresponds to a thin juice lime content of 0·030% CaO/100°Bx. In order to obtain a "normal" thin juice lime salts content it is necessary to increase the lime concentration where muds or juice are returned. The advantages and disadvantages of this technique are discussed ; it is found to be beneficial only to the filtration station. A reduction of the defecation juice volume would reduce the lime salts content of the thin juice, and would reduced the amount of work to be done by the ion-exchangers, installed to combat the abnormality, the pumps and the other juice stations.

* * *

The Durability of Rotary Diffusers. M. S. GABOVICH. *Sakhar. Prom.*, 1958, (4), 8–11.—Causes of structural weaknesses in rotary diffusers are discussed. Incorrect distribution of the support bands is considered the main source of trouble, individual joints suffering as a result of unbalanced loading. Metal fatigue is also regarded as a contributory factor, especially where the diffuser has been operating at a high rate over a long period. Drum corrosion, occurring where a temperature drop below 70°C causes a drop in pH, is also mentioned. Various remedies are proposed.

* * *

Improvement in the Technology of the Calcium Saccharate Process. A. T. YUROV. *Sakhar. Prom.*, 1958, (4), 18–21.—At Artemovsk factory it was found difficult to filter the thick hot saccharate suspension, the high temperature and alkalinity shortening the working life of the filter cloths to 4–5 days. Tempera-

[1] *Cf. I.S.J.*, 1958, **60,** 271.

ture control during filtration was also difficult. Under the scheme adopted to overcome these snags, which is used in several factories in the U.S.A., the hot saccharate from the settler is dissolved and re-crystallized in the cold saccharate reaction vessels and is then fed to the molasses in the molasses solution mixing tank. The mixture is then sent to the precipitator. The cold saccharate suspension is easily filtered and the working area of the separation plant reduced by discarding the three vacuum filters and the hot saccharate screw conveyor. Methods of combating foam accumulation are suggested and a proposed flow sheet is given. A formula for calculating the lime requirements is also given.

* * *

The Use of Artificial Cooling—The Most Important Step in Increasing the Efficiency of Sucrose Recovery from Molasses. E. A. MOGIL'NYI. *Sakhar. Prom.*, 1958, (4), 22–30.—Diagrams and full details are given of two steam jet ejector flash evaporation coolers, designed to precede the cold saccharate heat exchange coolers in separation plants and thus reduce lime consumption.

* * *

The Standard Calcium Saccharate Process for Sucrose Recovery from Molasses. ANON. *Sakhar. Prom.*, 1958, (4), 31–32.—A modified scheme for the calcium saccharate process was studied at a recent meeting at the Office of State Construction. The basic change was the adoption of double filtration for the cold saccharate suspension with intermediate washing of the saccharate cake in a mixer. For this it was proposed to employ all the vacuum filters used for the hot saccharate plus one of the cold saccharate filters, the hot saccharate being returned to the molasses solution mixing tank from the settler (*cf.* YUROV : *I.S.J.*, 1959, **61**, 87). To overcome foam formation, gravity feed should be used instead of the pumps. The use of centrifugal separators, e.g. to concentrate the hot saccharate suspension, is discussed, and the experimental use of these in other countries to concentrate the precipitate from predefecation juice is mentioned. The need for laboratory and factory trials of the suggested scheme is emphasized.

* * *

Purification of Green Molasses with Ion-Exchange Resins. E. YA. GOISMAN. *Sakhar. Prom.*, 1958, (4), 38–39.—Green molasses was treated in an ion-exchange plant in factory trials at Biisk factory. The final molasses sugar content was reduced from 3·21 to 2·79 and 2·65% on beet and the yield from 6·06 to 5·46 and 5·30% on beet. The author's view that, where there is no 3-product boiling system, the green molasses should be treated by ion-exchangers rather than 2nd carbonatation juice is not supported in an editorial note, where it is pointed out that it is better to treat the juice using two pairs of exchangers in parallel with another two pairs. The amount of sweetening-off water after treatment of the green molasses will always be greater than that after 2nd carbonatation juice treatment.

Spray Sulphitation. M. G. VASYNIN. *Sakhar. Prom.*, 1958, (4), 39–40.—The performance of the spray sulphitation equipment for thick syrup and a rotary sulphur burner installed at Olymsk factory in 1957 is discussed and some defects are mentioned.

* * *

Optimal Point of Second Saturation. M. BRUNASSO. *Ind. Sacc. Ital.*, 1958, **51**, 55–59.—The dissociation of H_2CO_3 is considered for different pH values and it is concluded that the pH of 9·25, as considered by BRIEGHEL-MÜLLER and BRÜNICHE-OLSEN, is optimal, higher or lower values producing factors which adversely affect the removal of lime salts.

* * *

Purification of Beet Juices with Emphasis on Filtrability. B. NOWAKOWSKI. *Gaz. Cukr.*, 1958, **60**, 141–151.—The difficulties encountered in juice purification are discussed, with emphasis on predefecation and the effect of this on filtration. The factors affecting filtrability are considered with reference to Poiseuille's equation, according to which the filtration coefficient F_k should be ≥ 10, as a value higher than this characterizes a filter-cake containing large particles, which is difficult to sweeten-off. Determinations were made of F_k at 8 sugar factories in the Poznan Department using the BRIEGHEL-MÜLLER microfilter. Although predefecation reduced the value from an average of 32·8 to only 11·8, with a corresponding filter pressure reduction from 3·6 to 1·58 atm., this is still considered beneficial to the filter station, as it also reduces sugar losses, sweetening-off time (to 3–4 min) and the amount of sweetened-off cake by 80%. Detailed results are tabulated.

* * *

Diffusion Juice Production with the Aid of Electroplasmolysis. A. YA. ZAGORUL'KO. *Sakhar. Prom.*, 1958, (5), 11–18.—The theories of plasmolysis, and especially selective electroplasmolysis[1], are discussed with the aid of equations. Experiments were carried out with an oscillograph to determine energy requirements. From the results was obtained an equation for the determination of these requirements and it is shown that for 100 metric tons of beet per 24 hr these are 4·3 kW for the roots and 3·0 kW for the cossettes.

* * *

Accumulation of Colloids in Beet Sugar Products. G. E. ORLOV. *Sakhar. Prom.*, 1958, (5), 18–22.—Frothing and other difficulties in boiling and filtration were encountered when frozen beet was processed at the Stalin factory. Determinations of the colloid contents of juices and molasses from beets at different periods throughout the campaign showed considerable increases by the end of the season. The colloid content of diffusion juice from beet stored for 3–3½ months may be increased by 35–45%, even though the beet appear healthy, while in diffusion juice from actually deteriorated beet, the colloids may increase by 220–240%.

[1] *Cf. I.S.J.*, 1958, **60**, 239.

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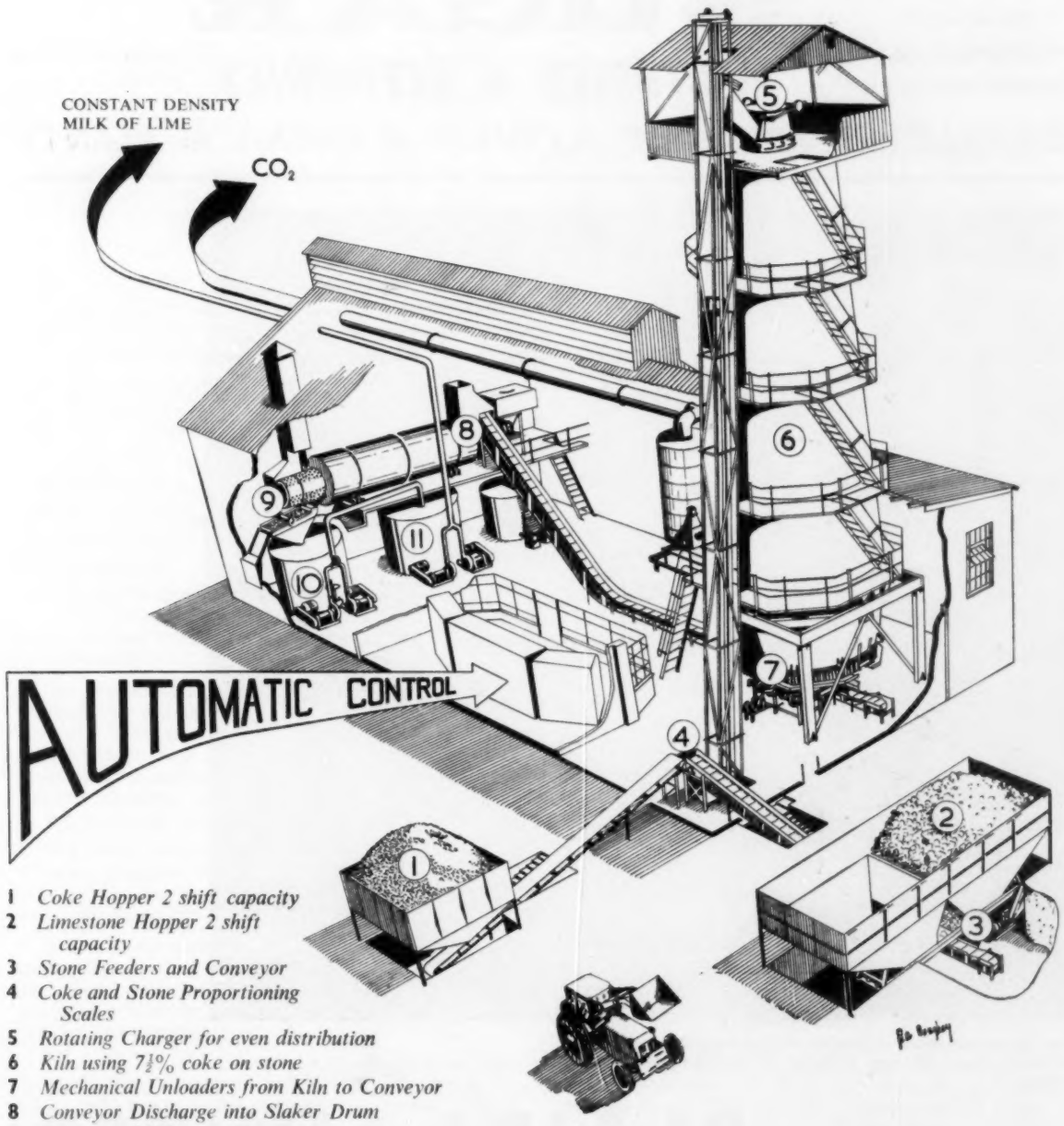

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Basic Calculations for the Cane Sugar Factory. J. EISNER. 24 pp ; 7½ × 10 in. (Booker Brothers McConnell & Co. Ltd., Bucklersbury House, 83 Cannon Street, London, E.C.4.) 1958. Price : 7s. 6d. ($1.00 U.S.)

Mr. EISNER has presented in this small booklet the calculations for the main operations in modern cane sugar factories, subdivided into 11 chapters :

1. Juice extraction by the mills.
2. Liming of juices.
3. Clarified juice and syrup.
4. Calculation of the amount of commercial sugar manufactured and final molasses produced.
5. Amounts of massecuite by different boiling systems.
6. Steam requirements.
7. Power and steam consumption.
8. Steam generation.
9. Heating surfaces in boilers, heaters and evaporators.
10. Condensers.
11. Available heat and bagasse in relation to steam production with some notes on flash evaporation, superheated steam and on the crystallization process.

This manual has been compiled primarily for the technologists responsible for the day to day operations and who have not the training, experience, time or inclination to study the voluminous textbooks which have been devoted to a complete analysis of the many specific problems connected with technical control in modern sugar mills.

This small booklet is, in the opinion of the reviewer, of great practical value to everybody who has responsibilities for operating plants. It is written in very understandable language and it is short.

The reviewer does not share the opinion of the author that his booklet is primarily for the operational staff members of a factory, for it has its great merits for practically everyone who has to deal with technical control in sugar factories.

The book has been written specifically for countries using the English system, with B.Th.U., °Fahrenheit, sq.ft., which limits its usefulness to certain sugar producing areas. It should be realized that the metric system and the use of absolute pressure and the Centigrade scale is applied in more countries today than it was in the past. But this does not take away the value of this booklet as it is simple for those who have to express their operational results in the metric system to use this manual by converting the examples as presented in their own system.

For the technologists who are interested in making the necessary calculations for the performance and efficiency of the individual stations, this manual is a most valuable help, and Mr. EISNER deserves our gratitude that he has presented it to the sugar world.

PIETER HONIG.

* * *

The Sugar Economies of the South American Continent. Ed. H. AHLFELD. 30 pp; 8¼ × 11¾ in. (F. O. Licht K.G., P.O. Box 90, Ratzeburg, Schleswig-Holstein, Germany.) 1958.

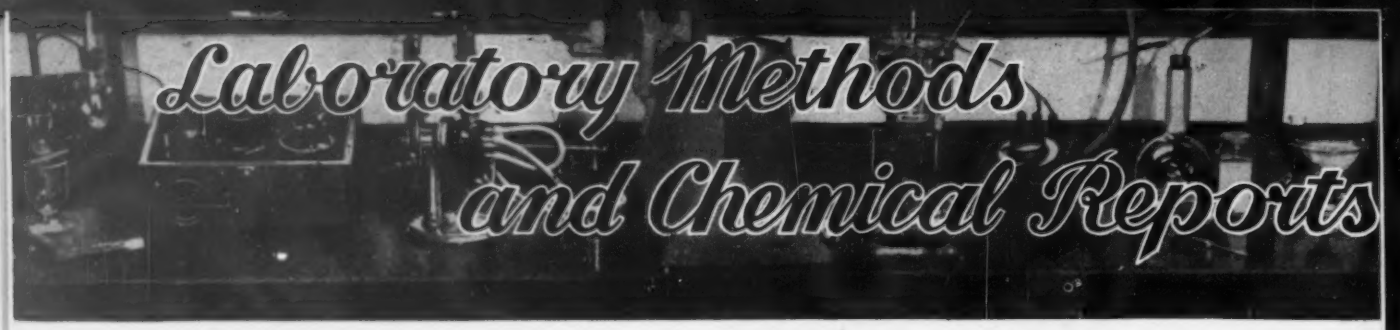
The history and development of the sugar industries of Brazil, Argentina and Venezuela are described in short articles, while the present situations in Peru, Chile, Colombia, Bolivia and Paraguay are discussed in further articles. Comparatively brief notes are given on the sugar economies of other South American sugar producing countries—Uruguay, British Guiana, Surinam and Ecuador. Some of the articles are written by sugar authorities of the countries concerned and the others are prepared by F. O. Licht staff writers.

A statistical section gives details of the sugar balance of South America as a continent ; production, imports, exports and consumption by individual countries ; and campaign results of the past ten years for Argentina, Brazil, Peru and Venezuela, with 1938/39 results for comparison in all but the last case.

* * *

Plantation Crops. 178 pp ; 7¼ × 9½ in. (H.M. Stationery Office, London E.C.1.). 1958. Price : 5s. 0d.

This work, subtitled "A review of production, trade, consumption and prices relating to sugar, tea, coffee, cocoa, spices, tobacco and rubber", was published for the Commonwealth Economic Committee. The section on sugar covers 24 pages and includes 18 tables of sugar production, cane and beet areas, yields per acre, imports and exports, etc., stocks, consumption and prices, with a discussion of these subjects in the accompanying text. The data refer to seasons up to 1956/57 with estimates of the 1957/58 season. An appendix gives details of the International Sugar Agreement of 1953 and the Commonwealth Sugar Agreement, while others refer to Government decrees affecting sugar production and trade in the various Commonwealth countries ; and cesses and duties of sugar products in countries of the Commonwealth and their customers.



Determination of Chlorides in Sugar Solutions. P. V. DENISOV and O. I. BELOVA. *Trudy Inst. Khim. Akad. Nauk Kirgiz S.S.R.*, 1956, **7**, 69–77 ; through *S.I.A.*, 1958, **20**, Abs. 276.—The usual method of chloride determination in molasses by ashing is shown to be unreliable, the Cl loss by volatilization during ashing depending on the intital Cl concentration and the amount of sucrose present. Direct potentiometric titration with a saturated calomel half-cell and a silver chloride electrode is recommended. Concentrated solutions are diluted to not more than 5% of sucrose, acidified with 4*N* nitric acid and titrated with standard silver nitrate solution. Variations of sucrose content (within specified limits), duration of titration, or presence of impurities in the molasses do not affect the accuracy.

* * *

Viscosity of Refinery Molasses. I. F. ZELIKMAN and T. A. ABDULLAEV. *Doklady Akad. Nauk Uzbek S.S.R.*, 1956, (12), 29–33 ; through *S.I.A.*, 1958, **20**, Abs. 279.—The viscosity η of refinery molasses, the total solids (°Brix) and temperature T can be represented by the following expressions :

$$\log \eta = \log A + B \frac{\text{°Bx.}}{100 - \text{°Bx.}}$$

and $$\log \eta = \log M + \frac{N}{T}$$

where A, B, M, and N are empirical constants. Hence $\log \eta$ is a linear function of $\frac{\text{°Bx.}}{100 - \text{°Bx.}}$ and of $\frac{1}{T}$. These relationships are applied to experimental data to give a nomogram for determination of the concentration of refinery molasses which corresponds to a given viscosity at a given temperature.

* * *

Hydrolysis of Carbohydrates in the Presence of Hydrochloric Acid or Acidic Ion-Exchange Resins. S. KAICHI. *Bull. Chem. Soc. Japan*, 1957, **30**, 844–847; through *S.I.A.*, 1958, **20**, Abs. 280.—Potato amylose (2% solution in *N* NaOH) was hydrolysed at 65°C and sucrose (20% solution) at 50°C, using HCl or resin in each case. The resin was almost ineffective in action on the amylose, whilst hydrolysis was rapid with HCl. With sucrose, the efficiency of the resin was somewhat less than that of the HCl ; from the rate constants it is concluded that the origin of the action of the resin is partly on the surface and partly in the whole resin phase, and the rate is therefore dependent upon the diffusion rate of sucrose in the resin. With HCl, the rate constant was directly proportional to the acid concentration.

Chemical Control in Sugar Factories. B. B. GAIROLA. *Indian Sugar*, 1958, **7**, 755–762.—The influence of temperature and lead acetate quantity on the polarization of cane juice are discussed and the drawbacks of the pol basis of chemical control are briefly mentioned. Objections to the use of a sucrose basis are referred to, including the variety of methods of inversion, and these are considered to be more important than the objections to the pol basis. Inaccuracy of hydrometric Brix measurement with solutions which are impure and/or of high concentrations are mentioned. In such cases as molasses, the dilution at which the Brix was measured should be stated, and a dilution of 1 in 5 is recommended.

* * *

Use of Ethylene Diamine Tetraacetic Acid in Increasing Sugar Recovery. S. N. G. RAO, S. L. PHANSALKAR, N. A. RAMAIAH, S. K. D. AGARWAL and S. C. JOLLY. *Sharkara*, 1958, **1**, (1), 28–36.—*See I.S.J.*, 1958, **60**, 298.

* * *

Viscosity of Crystal Suspensions. F. H. C. KELLY. *Sharkara*, 1958, **1**, (1), 37–45.—The various expressions derived for the viscosity of suspensions are examined and the relationship found most useful by the author is mentioned, viz.:
$\eta_{sp} = (X)^a$, where η_{sp} is the viscosity, X the volume fraction of the liquid phase, and a a factor given by $a = -6{\cdot}49\, l^{0{\cdot}276}$, where l is the crystal length in mm. The limiting viscosity of massecuites is discussed[1].

* * *

Measurement of Carbonates in Sugars with the Warburg Apparatus. P. L. DEVILLERS. *Sucr. Franç.*, 1958, **99**, 137–138.—A detailed description is given of the method used to measure the carbonate content of various types of sugar by means of the Warburg apparatus.

* * *

Methods for Determining Water in Refined Sugars, Including the Newly Devised Cobaltous Bromide Method. S. D. GARDINER and H. J. KEYTE. *Analyst*, 1958, **83**, 150–155.—For total water determination the sample is ground with $CHCl_3$ and CCl_4 in a flask containing stainless steel balls until it has a surface area of 3500 ± 200 sq. cm./g. A standard $CoBr_2$ solution in $CHCl_3$ is introduced through a "pipette" flask connected to the first under "dry air" conditions. After a further 10 min rotation of the first flask the liquid is filtered through a filter tube into a third flask and an aliquot of the filtrate evaporated and

[1] *See I.S.J.*, 1957, **59**, 92–93.

weighed to determine the residual $CoBr_2$. The $CoBr_2$ precipitated is calculated and the water in the sample obtained by reference to a calibration graph. Surface moisture may be determined similarly, omitting the grinding. The method is compared with oven drying and vacuum distillation.

* * *

Influence of Suspended Solids on the Brix of First Expressed Juice. R. DEICKE. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 159–161.—First expressed juice samples were collected and the Brix determined using a spindle, pycnometer and refractometer on unfiltered material and material which had been filtered with the aid of "Standard Supercel" through a Buchner funnel (vacuum filtration had been shown not to affect the readings perceptibly). The average values for the six determinations on eighteen juices are tabulated, and it is concluded that the influence of suspended solids on measurements by all three techniques was significant while there was no marked variation in accuracy between the methods. It had been expected, however, that the range of variation would have been greater with the refractometer as the instrument used was not new and the line of division was not sharp.

* * *

Determination of Dry Substance in Molasses and Massecuites. E. T. RELF. *Proc. 25th Conf. Queensland Soc. Sugar Cane Tech.*, 1958, 189–193.—The use of steam, water or electrically heated ovens, with or without circulating fans, is condemned, and the drying *in vacuo* at 140–145°F with a continuous dried air bleed over 16 hours recommended. Filter paper rolls, of 550 sq. cm. area for 1 g of sample, diluted with 1·5 ml of water, give better results than the sand method. Both sucrose and glucose are stable under the conditions of this technique.

* * *

Variations in the pH and Resistivity of Sugar Solutions with their Sucrose Content (Non-Sugars Constant). P. L. DEVILLERS. *Ind. Alim. Agric.*, 1958, **75**, 393–398.—Sucrose, purified by treatment with ion exchangers, was added to solutions of HCl, KOH, KCl, and vinasse (so as to approximate to the non-sugars present in molasses). The pH and resistivity were measured for different sucrose contents and the results discussed. With HCl, the pH decreased with increasing sucrose content, parallel, almost linear, curves being obtained for different initial pH values when the results were plotted on a graph. Equations are derived for the curves for up to 40% and for 40–90% sucrose. The fall in pH is attributed to "binding" of some of the water solvent by sucrose (calculated as approximately 50% in dilute solution and about 5% in saturated solution), increasing the concentration in the remainder. Resistivity (ρ) increases with sucrose content (this is attributed to the same cause) and a relationship is found whereby $\frac{\rho^2}{\eta}$ is a constant, η being the viscosity of the solution. Addition of sucrose to 0·02 N KOH solution reduces the pH from 12·3 to 10·2 at 66% sucrose ; the sucrose acts as a weak acid, partly neutralizing the alkali. The accompanying increase in resistivity is attributed to formation of a weakly ionized potassium sucrate. With 0·1 N KCl solution the pH does not vary significantly, but the resistivity increases considerably ; this is attributed to formation of a weakly ionized KCl-sucrose combination. With 2% vinasse solution, which is weakly acid, the pH changes only from 5·56 to 5·41 on addition of 68·3% sucrose. The resisitivity increases and it is considered that the salts present also form weakly ionized compounds with sucrose.

* * *

Application of Sodium Glutamate in the Detection and Determination of Sugars. M. CHIONG LIZÁRRAGA. *Anales Fac. Farm. Bioquím. Univ. Nac. Mayor San Marcos*, 1955, **6**, 588–592 ; through *S.I.A.*, 1958, **20**, Abstr. 381.—An alkaline copper sulphate and sodium glutamate reagent has been found to give results in the determination of reducing sugars in agreement with those obtained with FEHLING's solution (Soxhlet modification). The copper-glutamate reagent has the advantage of becoming rapidly and completely decolorized on reduction. The stock solutions are made up separately, since glutamic acid loses ammonia in strongly alkaline solutions. The reagents are : (A) 11·45 g of $CuSO_4,5H_2O$, 57·7 g of monosodium glutamate, 1000 c.c. of water ; (B) 160 g of anhydrous Na_2CO_3, 12 g of NaOH, 1000 c.c. of water ; (C) 1% $K_4Fe(CN)_6$ solution. The reagent mixture is 5 c.c. of (A), 5 c.c. of (B), and 0·5 c.c. of (C) with 40 c.c. of water. The ferrocyanide may be added in the cold or to the boiling solution. Results are tabulated for analyses of glucose, lactose, hydrolyzed lactose or hydrolyzed sucrose.

* * *

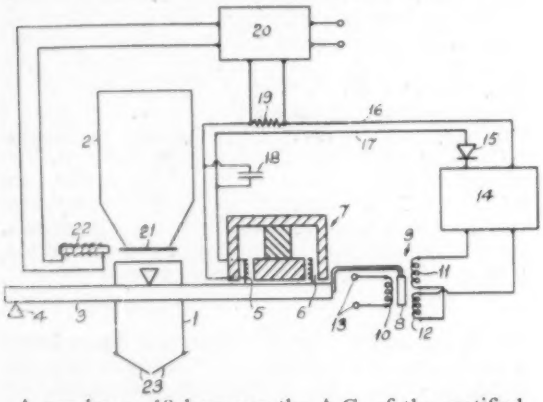
The Application of Magneto-Rotation in Photoelectric Polarimeters. H. WENKING. *Zucker*, 1958, **11**, 283–286.—Two new polarimeter principles are described. In the first, the monochromatic light is polarized by a graduated rotary polarizer and after passing through the sample cell is split into perpendicular components by a Wollaston prism. The light passes through a magneto-optically active substance in an alternating magnetic field ; this modulates the plane of polarization and the light then passes via a fixed analyser, set at crossed position relative to the polarizer, to a D.C. photoelectric cell. A signal is produced, comprising a carrier signal and an alternating signal, which corresponds to the alternating frequency of the magnet. Return of the unmodulated section of light to zero by adjustment of the rotary polarizer gives a null reading, the accuracy (up to $\pm$ 0·001°) depending on the angle of modulation of the secondary signal. In the second scheme the Wollaston prism is omitted. A description is given of an automatic instrument using the principle of the second scheme above, in which the polarizer is rotated by the signal produced in the photo-cell. Accuracy is stated to be within $\pm$ 0·005°.

PATENTS

Beet Harvesters. T. S. JOHNSON, of March, Cambs. **805,506**. 9th October, 1957 ; 10th December 1958.

* * *

Weighing Machines. TATE & LYLE LTD., S. HILL, and J. T. RUNDELL. **805,556**. 5th November 1956 ; 10th December 1958.—Receptacle 1 is mounted on a beam 3 which pivots about axis 4. The beam carries a cylindrical coil 5 which enters the airgap 6 of an annular magnet 7. In the unloaded position, the weight of the beam and receptacle 1 is supported by the upwardly directed force produced by the current flowing through the coil 5. The shutter 21 of hopper 2 opens and feeds receptacle 1, so depressing the beam and with it the core 8 of a differential transformer 9. The downward displacement of the core relative to the windings 10, 11, 12 causes an A.C. voltage to be generated in the winding 11 and 12, 10 being connected to an A.C. source. This voltage passes through amplifier 14, rectifier 15 and is fed to coil 5 through leads 16, 17. An increased upwardly directed force then operates on beam 3. The deflection of the beam and core 8 will continue until the downward force is just neutralized by the upward magnetic force.



A condenser 18 bypasses the A.C. of the rectified current, and a resistor 19 is connected to lead 16 and to an electric servo system 20 which controls the shutter 21. As the receptacle fills with material the current in coil 5 increases and so the voltage fed to the servo system. The rate of closing and moment of final closing of the shutter can be adjusted to this voltage and the receptacle may then discharge automatically by any suitable means.

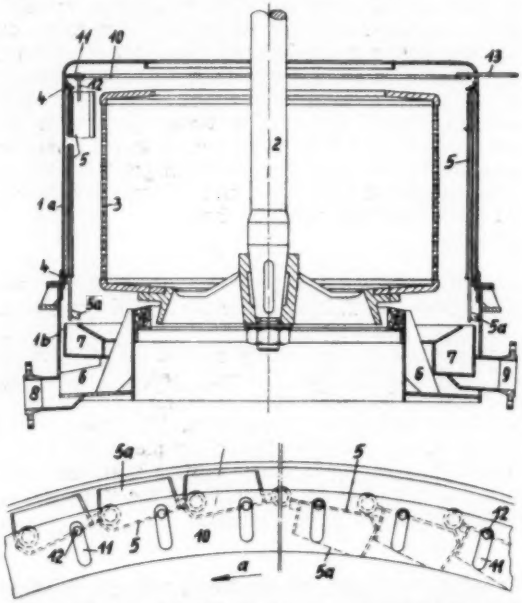
* * *

Dissolving Sugar. AMALGAMATED SUGAR CO., of Ogden, Utah, U.S.A. **806,378**. 30th April 1957 ; 23rd December 1958.—Cf. U.S.P. 2,809,903[1].

* * *

Syrup-Separating Device for Sugar Centrifugals. MASCHINENFABRIK BUCKAU R. WOLF A. G., of Grevenbroich, Germany. **806,587**. 5th September 1957 ; 31st December 1958.

Angle iron rings 4, under the curb and at the bottom of centrifugal housing 1a, carry a number of overlapping catching walls 5 which have dropping plates 5a at the bottom of each. Underneath the plates 5a, the bottom part of the housing 1b forms a channel 6 while a second channel 7 is concentrically mounted with spacing from the side walls and from the bottom of the housing. The channels are provided with drains 8 and 9 respectively. The walls 5 and plates 5a pivot horizontally so that when in the position shown on the right of the lower drawing, the liquor passing through the basket is trapped by the walls 5 and directed into channel 6. When the walls are pivoted into the position shown on the left of the lower drawing, the liquor is directed into channel 7.



Above the catching walls 5 is a horizontal adjusting ring 10 which possesses radial guide slots 11 into which extend pins 12 on the top of walls 5. As the ring 10 is rotated by means of lever 13, the pins 12 slid in the guide slots and cause the walls 5 to pivot from one operative position to the other. Thus by movement of lever 13, the liquor passing through the basket can be separated into separate drains 8 and 9 ; thus it is possible to segregate molasses and wash syrup by movement of the lever 13.

* * *

Centrifugals. THOMAS BROADBENT & SONS LTD., of Huddersfield, Yorkshire. **806,821**. 15th August 1957 ; 31st December 1958.

The centrifugal basket *a* is carried upon and rotated by a shaft *b* carrying a brake pulley *c*. The shaft is supported in a bearing housing *d* with an upward

[1] *I.S.J.*, 1958, **60**, 148.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 3s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

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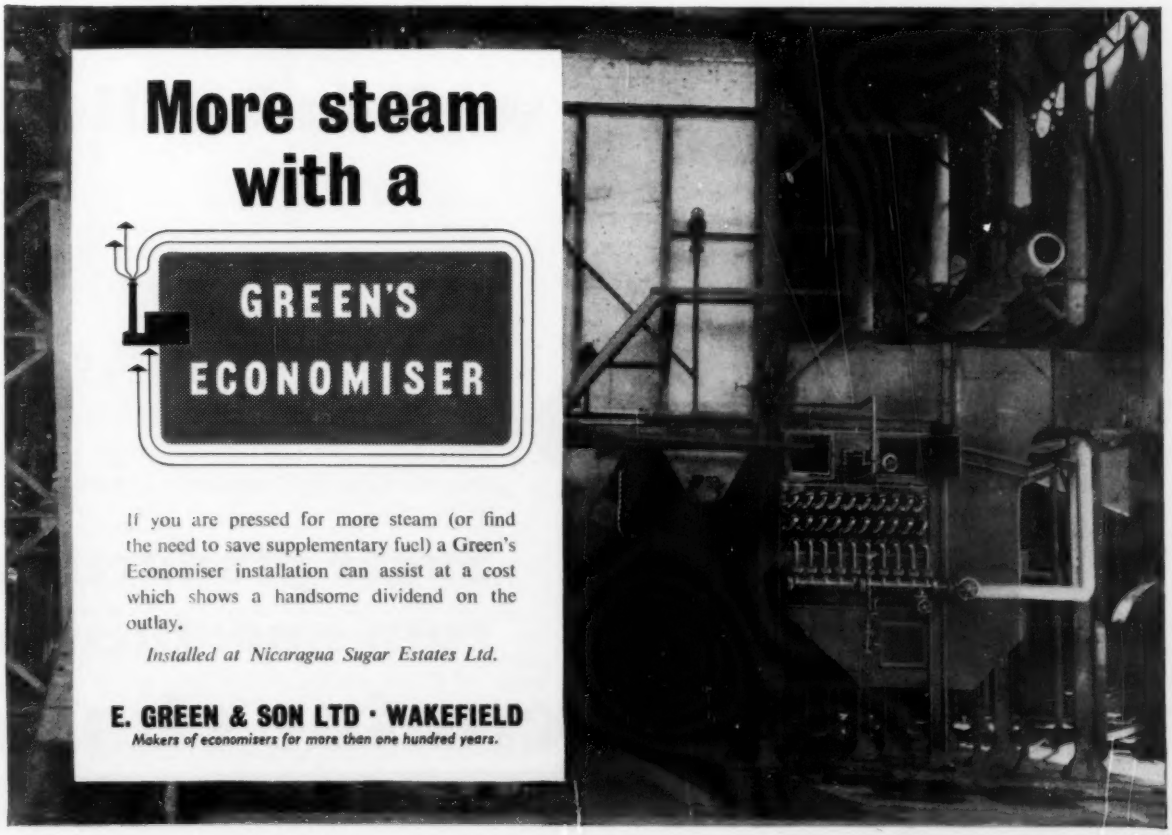

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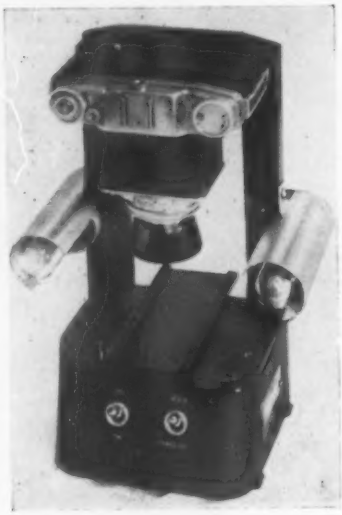

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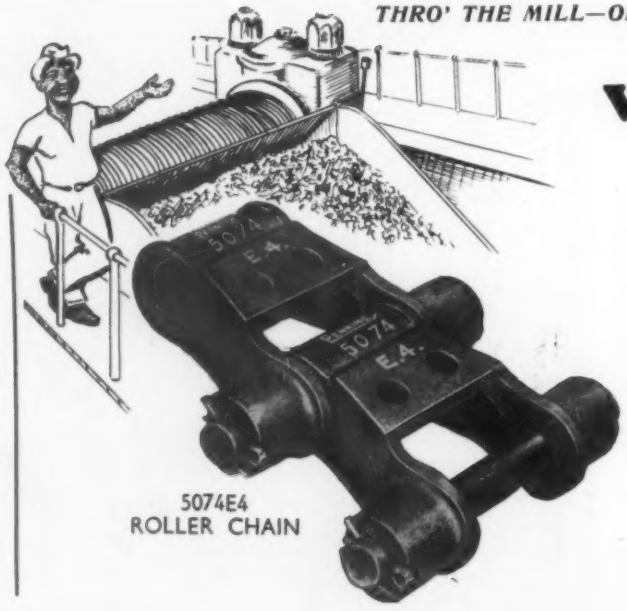

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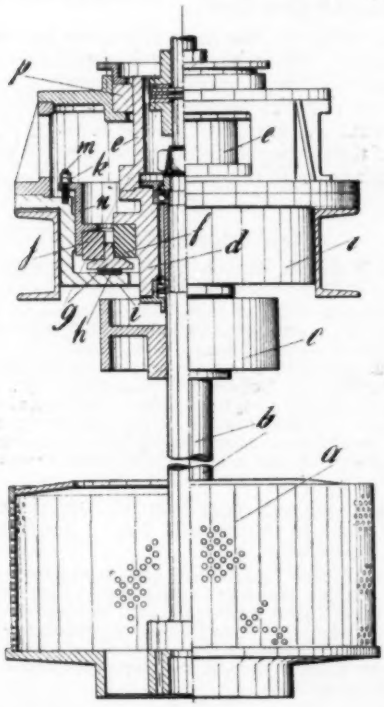
INTERCHANGEABLE WITH OTHER MAKES

Pennine chain

Catalogues on request: PENNINE CHAINBELT CO. LTD., ARMLEY, LEEDS 12, ENGLAND

extension *e* secured to it. The housing *d* is supported by an india-rubber or similar flexible ring *f* which rests on one side of a ring *g* of inverted T section, riding upon a friction surface *h* located in a fixed member *i*. There is a second flexible ring at *j* which rides on the other side of the ring *g* ; the pressure exerted by the ring *j* on the ring *g* can be adjusted by adjusting the nuts *k* on the screws *m* in the fixed member *i*, the nuts pressing on the ring *n* which has an internal flange *o* resting on the flexible ring *j*. The upper end *e* of the bearing housing extension comes within a resilient ring *p* which locates the housing, and allows movement of the latter and of the spindle *b* during the operation of the centrifuge.



When the basket *a* is being charged and is accelerating, the spindle *a* sways around its vertical axis, carrying with it the bearing housing *d* and its extension *e*. The latter pivots in the flexible ring *p* and consequently the spindle imposes a lateral force on the flexible ring *f* and tends to move the seating ring *g* over the friction surface *h*, compressing slightly the outer flexible ring *j*.

As the machine speed increases, the lateral motion of the spindle *a* decreases until it can be accommodated in the flexible rings *f* and *p*. The seating ring *g* becomes stationary on the friction surface *h*. If, however, the machine should tend to precess, the increasing lateral motion of the spindle *b* causes the ring *g* to move over the friction surface *h* and to compress the ring *j*, so causing increased pressure on the friction surface *h* and increased resistance to the lateral movement by the action of the ring *j*. The nuts *k* are adjusted to give the desired pressure of the ring *g* on the friction surface *h*.

The flexible ring *p* acts as a pivot for the spindle *b* in its lateral movements. It can be replaced by mechanical pivoting means, such as a spherical bearing or a barrelled bush.

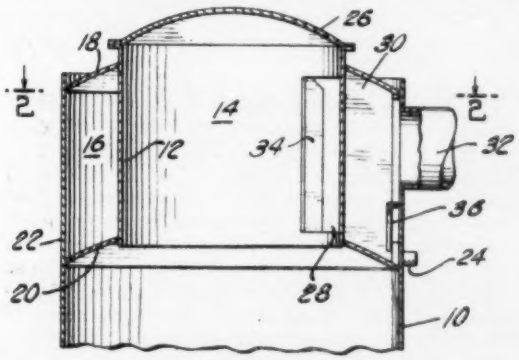
* * *

UNITED STATES

Beet Harvesters (1) **(Rake Wheel).** K. B. SORENSON, C. S. MORRISON, G. H. SHRIVER and A. J. BJERKAN, assrs. DEERE & CO. INC. **2,856,745**. 6th August 1954 ; 21st October 1958. (2) S. C. HETH, J. C. JOZWIK and S. O. VIFOT, assrs. J. I. CASE CO., of Racine, Wis., U.S.A. **2,865,461**. 19th September 1955 ; 23rd December 1958.

* * *

Entrainment Separator. H. G. LANKENAU, assr. CHICAGO BRIDGE & IRON CO., of Chicago, Ill., U.S.A. **2,859,832**. A cylindrical chamber 14 of diameter less than the effect 10 is mounted over it and sealed by annular plate 20. The wider cylinder of the effect extends as wall 22 of the annular chamber 16 surrounding chamber 14 and sealed by annular plate 18. Vapour rises into chamber 14 and is transferred to chamber 16 by passing through slot 28. It is directed to the periphery by baffle 34, whereupon droplets recovered



by centrifugal force collect, drain into the channel formed by ring 20 and wall 22 and so out through pipe 24. The vapour passes almost completely round the chamber 16 and then leaves by way of pipe 32 as it cannot pass beyond the barrier plate 30 which extends the whole depth of chamber 16. Entrainment of liquid from the annular collecting channel near the vapour exit is prevented by the shield 36.

* * *

Japan-Brazil Trade Agreement.[1]—Under the terms of a trade agreement which has recently been negotiated, Japan and Brazil will each endeavour to purchase commodities from each other to the value of $42,500,000 during the space of one year. Listed in Japan's import programme is sugar, for which the equivalent of $9 million is earmarked, sufficient to purchase about 120,000 tons.

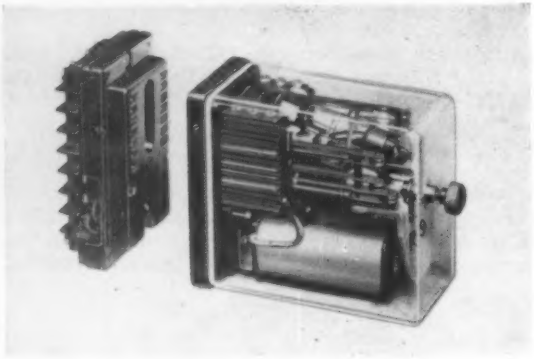
[1] C. Czarnikow, Ltd., *Sugar Review*, 1958, (379), 191.

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

New Plug-in Relays. D. Robinson & Co., Gunnersbury House, 717 London Road, Hounslow, Middlesex.

The Plug-in D.C. Mains Relay Type 2600 B is for use with control systems using 110–240 volts D.C. and has contacts of arc-suppressing material, two with permanent magnet arc blow-outs which can be used to switch small motors, klaxons and similar inductive loads taking up to about 5 amp at 240 volts. The other contacts can be used on 240 volts D.C. to switch such loads as lamps and relay coils.



The Plug-in Mercury Switch Relay Type 2600 H can have one or two mercury switches with N/O or N/C action rated at 6 amp at 500 volts or 240 volts D.C. Alternatively it can have a fleeting contact or "quick strike" mercury switch which gives a brief "make" when the relay is energised, but not when it is released, or vice-versa. Both the above types of relay are of unusually heavy construction but are so compact that the total panel space each requires is within 2¼ × 4 in. Each has a dust-tight moulded cover in transparent and non-inflammable material.

* * *

Schaffer Poidometers. Sheepbridge Equipment Ltd., Chesterfield, Derbyshire.

The "Poidometer" is essentially a machine for continuously feeding raw materials at a predetermined constant rate. The rate of flow can be adjusted during operation to suit changes in requirements and the machine can also be used to deliver batch weights of material by using it in conjunction with a timer device. Standard machines cover the range of 24 lb to 300 tons/hr, and can be used with a wide range of granular solid materials, including carbon, coal, lime, limestone, sugar, etc.

Material is fed from a hopper onto a flat rubber belt driven by an electric motor through a worm reduction box. The hopper opening is of inverted-V shape and the depth of material is determined by a vertical sliding gate. The main length of the belt is supported by a single weigh roller which, by means of a linkage mounted on knife edges, is connected and balanced by a scale beam in turn connected to the control gate. The beam is graduated and is set to deliver the weight of material required for each foot of belt travel. A recording device shows the cumulative number of feet travelled which gives the total weight handled in any given time.

As the weight of the material on the belt exceeds that required, the weigh roller is depressed and the control gate is lowered, reducing the carpet of material. Insufficient material on the belt similarly causes the gate to rise. An automatic device stops the "Poidometer" if the hopper should become empty. Accuracy of the order of 1% can be obtained.

* * *

PUBLICATIONS RECEIVED

LINK-BELT CANE SUGAR INDUSTRY EQUIPMENT. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

A new 64-page catalogue, Book 2640, provides a comprehensive review of the equipment made by Link-Belt for the cane sugar industry, some, of course, being suitable for the beet sugar industry as well. It is in ten sections and describes Link-Belt's manufacturing facilities ; cane handling ; juice, sugar and bagasse screening ; bagasse handling ; bulk sugar handling; bagged sugar handling ; sugar drying and cooling ; other materials handling and processing equipment ; power transmission products ; and a general information index.

* * *

ANTIFOAM AGENTS FOR THE SUGAR INDUSTRY. Charles H. Windschuegl Ltd., 1 Leadenhall St., London E.C.3.

"Antispumin 7517" is suitable for foam prevention in measuring tanks, clarifiers and carbonatation tanks for the cane sugar industry, while "Antispumin HF" used at the rate of 3–5 g per 100 tons of beet combats foaming in continuous diffusers and diffusion batteries,in beet flume water,and,at a concentration of 1—2 g per cu.m. of wash, in the baryta process for sucrose recovery from molasses.

* * *

FARREL SUGAR MILLS. Farrel-Birmingham Co. Inc., Ansonia, Conn., U.S.A.

Bulletin 312, a new 39-page booklet, is devoted to the cane mills and ancilliary machinery provided by Farrel-Birmingham. It is plentifully illustrated and gives detailed descriptions of the mill housing, bearings and hydraulic equipment, rollers and their fitting and removal, intermediate carriers, gearing, operation and control. Also described are Farrel cane knives, and a section of engineering data provides information on horsepower requirements in graph form, roll settings, cane knife horsepower, and a procedure for laying out turnplates.

* * *

SIGHT FLOW INDICATORS. B. Rhodes and Son Ltd., Queen Street, Romford, Essex.

A leaflet describing the Rhodes range of flow indicators is illustrated with photographs of the various types available. Their characteristic is the window through which the flow can be observed, with a spinner, flap or internal spout, or with an internal scale which gives an empirical measure of the liquid flow.

United Kingdom Sugar Imports and Exports.[1]

Tons	January/December 1958	1957
IMPORTS—		
Refined	30,114	49,389
Raws—Union of South Africa	170,689	107,834
Mauritius	393,503	453,202
Australia	334,474	459,427
Fiji	84,580	82,497
Jamaica	211,862	188,094
Leeward Is.	41,880	55,569
Windward Is.	8,297	9,268
Barbados	119,827	137,495
Trinidad	128,424	125,170
British Guiana	205,278	173,782
Other British	9,233	6,991
Total Commonwealth	1,708,047	1,799,329
Cuba	494,373	447,704
San Domingo	349,375	367,654
Peru	45,509	56,153
Brazil	42,374	134,600
Other Foreign	1,570	15,077
Total Foreign	933,201	1,021,188
Grand Total Raws	2,641,248	2,820,517
EXPORTS—Refined—		
Cyprus	14,261	8,157
Sierra Leone	9,696	7,409
Ghana	29,259	31,263
Nigeria	52,520	31,070
Bahrein, Qatar & Trucial Oman	11,657	17,975
Kuwait	13,585	10,467
India	6	6
Pakistan	7	11
Singapore	8,704	3,670
Malaya	66,920	30,338
Other Commonwealth	59,899	27,016
Norway	29,163	74,635
Western Germany	6,145	22,880
Netherlands	32,255	29,526
Switzerland	54,117	62,004
Greece	370	250
Libya	7,123	870
Sudan	6	40,889
Lebanon	1,429	2,723
Israel	352	6,301
Jordan	—	3,674
Saudi Arabia	26,378	24,444
Iraq	90,096	61,981
U.S.S.R.	—	108,628
Other Foreign	51,285	80,669
Total	565,233	676,856

[1] Board of Trade Returns, through C. Czarnikow Ltd., *Sugar Review*, 1959, (389), 20.

New Danish Research Laboratory. The Danish Sugar Corporation has decided to set up a new research laboratory at Nakskov which will be concerned with automatization, steam economy, etc. The Senior Engineer in charge will be Mr. C. MOLLER. The Central Laboratory will be split into two Divisions concerned, respectively, with manufacturing techniques and agricultural chemistry, under Messrs. N. J. LOFT and E. ANDERSEN. The present head of the Central Laboratory, Dr. A. V. BRIEGHEL-MÜLLER, is to act as Technical Consultant to the Corporation, while the Chief Engineer, Mr. H. BRÜNICHE-OLSEN, has been appointed Assistant Manager (Technical).

New Sugar Factory for Mexico[1].—A group of farmers and businessmen in San Luis Potosí has charged the National Chamber of Commerce of the Huasteca Potosina, Ciudad Valles, with arranging the acquisition of machinery and equipment for establishing a large sugar mill near Ciudad Valles.

* * *

Brazilian Sugar Strike[2].—Some 14,000 workers went on strike on the 29th December last, at a number of factories in São Paulo and Rio de Janeiro but returned to work on the 31st after they had been given a wage increase of 30% from the 1st January with an expected further increase of 10% in May. The factory price of sugar has also been increased by 30%.

* * *

London Terminal Market Changes[3].—"Open outcry" trading has been introduced on the London Terminal Market, with a smaller minimum fluctuation in prices. Previously, the minimum fluctuation was 1½d but in an endeavour to encourage more competitive trading and to make London a more attractive market on which to trade, particularly for the smaller trader and operator, the minimum fluctuation has been fixed at ¼d.

* * *

New Factories for Pakistan[4].—The Pakistan Industrial Development Corporation plans to build five new sugar factories, two of which will be in West Pakistan and three in East Pakistan. Two sugar factories were recently completed in East Pakistan : at Rangpur, with 20,000 tons annual sugar production, and at Thakoregaon, with 15,000 tons production capacity.

* * *

Crop Authorization in the Dominican Republic.—The Dominican Republic Sugar Commission has announced that the production of 987,027 metric tons of sugar has been authorised for the current season, of which 655,000 metric tons is destined for the world market, 68,210 tons for the United States and 85,312 tons is for domestic consumption. Reserves of 80,852 metric tons are to be held for any quota adjustment and increase in home demand, in addition to 97,653 tons not intended for human consumption.

* * *

Beet Sugar in Pakistan.—The author of our article of this title which appeared in the December 1958 issue was given as N. D. YUSUF, of the Department of Agriculture, Lyallpur, West Pakistan. Mr. YUSUF has drawn our attention to the fact that the article, although sent by him, was prepared by MIR OBAIDULLAH JAN, Sugar Specialist, Mardan. We offer our apologies to the latter and our thanks to the former for drawing our attention to the error.

* * *

Hawaiian Irrigation.—Hawaii is installing another portable overhead irrigation system. Kilauea Sugar Company, on the Island of Kauai, is planning to put 750 acres—150 of which have not previously been irrigated—under the new system. Water is a problem for Kilauea and the overhead system saves about 50% on water and provides a substantial saving in labour cost. Even with the 10 foot roadways necessary to provide towing areas for sprinkler units, the elimination of level and straight ditches, now in operation, provides 60% savings in land area, say plantation officials. The system initially includes three units, each consisting of a pump from sump, with suitable screens to exclude trash. From three to four pump sumps will be required for an average field. A six-inch aluminium pipe line and a riser with two rotating 70-foot booms will be used. Each riser has a wind operated valve which varies water output so that the pattern will be uniform, regardless of wind conditions. The sprinkler is a high capacity unit, rated at 685 gallons per minute at 70 lb per square inch working pressure. It is mounted on a four-wheel trailer and positioned by a heavy duty four-wheel drive pickup truck.

[1] *Foreign Commerce Weekly*, 26th January, 1959.
[2] *Sucr. Belge*, 1959, **78**, 274–5.
[3] *General Remarks on the Sugar Situation* (E. D. & F. MAN), 30th January, 1959.
[4] *Zeitsch. Zuckerind.*, 1959, **84**, 44.

BREVITIES

U.S.S.R. Beet Crop[1].—According to the Soviet Central Office of Statistics the 1958 production of beet reached 54,100,000 tons. This is an increase of 74% on the 1955 crop and is the target set for beet production by 1960.

* * *

New Cane Estate in Tanganyika[2].—It is planned to plant 5000 acres of sugar cane at the Mtibwa estate, Turani, 60 miles from Morogoro on the central railway in Tanganyika, which should produce 20,000 tons of sugar. It is expected that the production target will be reached within 3½ years ; a factory will then be ready.

* * *

Jamaican Factory to Close[3].—Long Pond Sugar Estate in Trelawny Parish has been bought by Trelawny Estates Ltd., a wholly-owned subsidiary of Distillers Corporation—Seagrams Ltd., of Montreal, which in 1957 bought the neighbouring estate of Vale Royal. The latter factory will be closed (it had a peak annual production of 11,000 tons of sugar) and all factory operations will be conducted at the more centrally located Long Pond factory. Vale Royal will, however, continue to be operated for the 1959 and 1960 sugar crops. Long Pond factory will be modernized at a cost of some £300,000.

Stock Exchange Quotations

London Stocks (*at 16th February* 1959)

	CLOSING MIDDLE
Anglo-Ceylon (5s)	16/9
Antigua Sugar Factory (£1)	17/6
Booker Bros. (10s)	24/6
British Sugar Corp. (Ltd. (£1)	19/9
Caroni Ord. (2s)	5/–
Caroni 6% Cum. Pref. (£1)	17/9
Distillers Co. Ltd. (6s. 8d units)	25/9
Gledhow Chaka's Kraal (£1)	67/6
Hulett & Sons (£1)	85/–
Jamaica Sugar Estates Ltd. (5s units)	6/9
Leach's Argentine (10s units)	11/9
Reynolds Bros. (£1)	54/–
St. Kitts (London) Ltd. (£1)	56/3
Ste. Madeleine (Ord.) (£1)	30/6
Sena Sugar Estates (10s)	22/6
Tate & Lyle (£1)	69/6
Tate & Lyle Investments Ltd. (5s)	16/4½
Trinidad Sugar (5s stock units)	33/6
United Molasses (10s stock units)	35/–
West Indies Sugar Co. Ltd. (£1)	27/–

New York Stocks (*at 16th February* 1959)

	CLOSING MIDDLE $
American Crystal ($10)	40
Amer. Sugar Ref. Co. ($100)	33¾
Central Aguirre ($5)	22
Cuban American ($10)	30¾
Great Western Sugar	28½
South P.R. Sugar	28⅜
United Fruit Co.	42½
West Indies Sugar Corp. ($1)	51¼

Argentina Sugar Factory[4].—A new corporation has been formed in Salta, known as Compañia Azucarera Saltena, which will erect a new sugar factory in Oran at an estimated cost of 100 million pesos, the machinery and equipment to be approximately 80% of national origin. It is estimated that initial capacity will vary between 1500 and 2000 tons daily.

* * *

Danish Production, 1958[5].—Production of beets for sugar production in 1958 amounted to 3,211,000 metric tons, compared with 3,064,000 tons in the previous campaign. The sugar crop is estimated at 360,000 tons, refined value, which will leave some 110,000 tons available for export. The 1957/58 crop amounted to 330,000 tons.

* * *

Argentina Cane Production, 1957/58.[6]—Production of cane n 1957/58 was 32% up on the previous season's outturn, according to provisional estimates prepared by the Department of Agriculture. The province of Tucumán is responsible for 71·6% of this crop. Provisional figures are 12,950,000 metric tons in 1957/58 compared with 9,810,000 tons in 1956/57.

* * *

Sugar Factories for Russia[7].—According to a V.W.D. report, the Soviet Union has ordered 30 sugar factories in Poland, Czechoslovakia and East Germany, to be delivered by 1961. The main supplier will be Czechoslovakia. East Germany is to deliver three factories of 1500 tons daily capacity and four of 2500 tons to the U.S.S.R. by the end of 1960, and a further factory of 1200 tons daily capacity to Bulgaria.

* * *

East Germany Sugar Industry Expansion Plans[8].—In 1961 it is planned that more than 7 million tons of beets will be worked, this figure increasing to 7,500,000 by 1965. During the Five-Year Plan for 1961—1965, the daily processing capacity of the East German sugar factories is to be raised by building a new factory at Güstrow, reconstructing 12 factories, and investment in replacements at 24 factories.

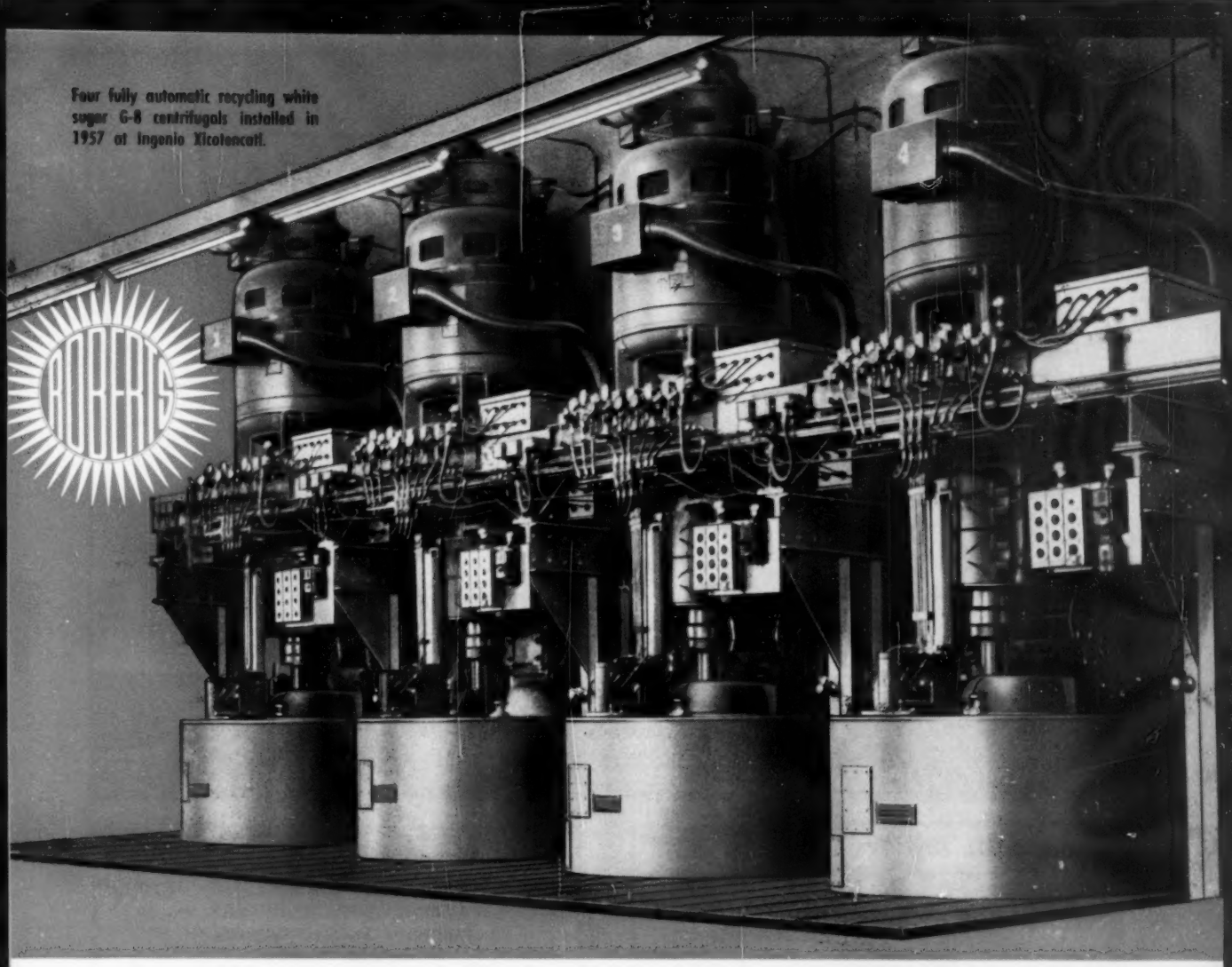
* * *

Dominican Republic Factory Expansion.—A £5-million expansion programme has been announced by the South Porto Sugar Co. at La Romana. The Company which has operated in the Dominican Republic for 47 years is planting an additional 6000 acres of sugar cane and enlarging its plant which will have an increased daily capacity of 16,000 tons of cane instead of the present 9000 tons.

* * *

Establishment of a Tunisian Sugar Industry[9].—Loaf sugar made in Tunis is now for sale on the local market and the State Secretaries for Finance, Commerce and Industry decided on 26th August to ban imports of beet and cane sugar in ground, sawn or cut loaves. Overall consumption in Tunisia is estimated at 70,000 tons, and Tunisians are taking steps to promote the cultivation of sugar beet (trials are under way in the Beja region) and to create a sugar industry able to satisfy local needs. As a first stage, a Tunisian Company (I.M.E.R.) started its factory on the first anniversary of the Tunisian republic and is currently converting imported sugar into loaf sugar. Potential production is 15,000 tons per year.

[1] F. O. LICHT, *International Sugar Report*, 1959, **91**, (1), 9.
[2] *Commonwealth Producer*, 1958, (368), 181.
[3] *West India Comm. Circ.*, 1958, **73**, 315.
[4] F. O. LICHT, *International Sugar Report*, 1958, **90**, (Supp. 24), 11.
[5] C. Czarnikow Ltd., *Sugar Review*, 1959, (388), 15.
[6] C. Czarnikow Ltd., *Sugar Review*, 1958, (380), 197.
[7] F. O. LICHT, *International Sugar Report*, 1959, **91**, (Supp. 1), 11.
[8] F. O. LICHT, *International Sugar Report*, 1959, **91**, (Supp. 1), 16.
[9] *Hautes Etudes Economiques*, 1st October, 1958.



Four fully automatic recycling white sugar G-8 centrifugals installed in 1957 at Ingenio Xicotencatl.

2766

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Index to Advertisers

	PAGE
Bellingham & Stanley Ltd.	li
Bellis & Morcom Ltd.	ii
Bennett, Sons & Shears Ltd.	xlix
Blairs Ltd.	xxix, xl
Thomas Broadbent & Sons Ltd.	iii
CECA	xli
George Clarke & Sons (Hull) Ltd.	vi
Cl: lesdale Chemical Co. Ltd.	xlix
Cocksedge & Co. Ltd.	xxxix
A. F. Craig & Co. Ltd.	xxiv
Crofts (Engineers) Ltd.	xxxvii
Dorr-Oliver Inc.	Inside Back Cover
Dunford & Elliott Process Engineering Ltd.	lii
Edwards Engineering Corp.	iv, v
Ewart Chainbelt Co. Ltd.	xliv
Soc. Fives Lille—Cail	viii
George Fletcher & Co. Ltd.	xxxii, Outside Back Cover
Fontaine & Co.	xliv
E. Green & Son Ltd.	xli
Grill Floors Ltd.	x
Gruendler Crusher & Pulveriser Co.	ix
G. M. Hay & Co. Ltd.	xlvii
Heenan & Froude Ltd.	vii
N. A. Helmer	xliv
Honolulu Iron Works Company	xlviii
Robert Hudson Ltd.	xlviii
Hudson & Wright Ltd.	xiv
Hunslet Engine Co. Ltd.	xi
Johns-Manville International Corp.	xvi
Kingston Industrial Works Ltd.	xii, xiii
Lee, Howl & Co. Ltd.	xlvii
Lepage, Urbain & Cie	xxxvi
Link-Belt Company	xv
John McNeil & Co. Ltd.	xxviii
Markham Traction Ltd.	xvii
Marshall, Sons & Co. Ltd.	xxvii
E. C. Masson	xliv
Mirrlees Watson Co. Ltd.	Inside Front Cover, i
Pennine Chainbelt Co. Ltd.	xlii
Pott, Cassels & Williamson Ltd.	xxxviii
Power Plant Co. Ltd.	l
Rotameter Mfg. Co. Ltd.	l
Sack Filling & Sewing Machine Syndicate	xix
Salzgitter Maschinen A.G.	xviii
Saunders Valve Co. Ltd.	xx
Richard Simon & Sons Ltd.	li
A. & W. Smith & Co. Ltd.	xxx, xxxi
Squier Corporation	xxxiii
Duncan Stewart & Co. Ltd.	xxxv
Stork-Werkspoor N.V. (V.M.F.)	xxii
Suchar Engineering & Sales Co.	xxxiv
Sugar Manufacturers' Supply Co. Ltd.	xlii, xlv
John Thompson Water Tube Boilers Ltd.	xxi
Watson Laidlaw & Co. Ltd.	xxvi
Western States Machine Co.	xliii
Joseph Westwood & Son Ltd.	xlv
Whitlock Bros. Ltd.	xxiii

FOR BUYERS' GUIDE SEE JANUARY ISSUE, pp. xxxix-l

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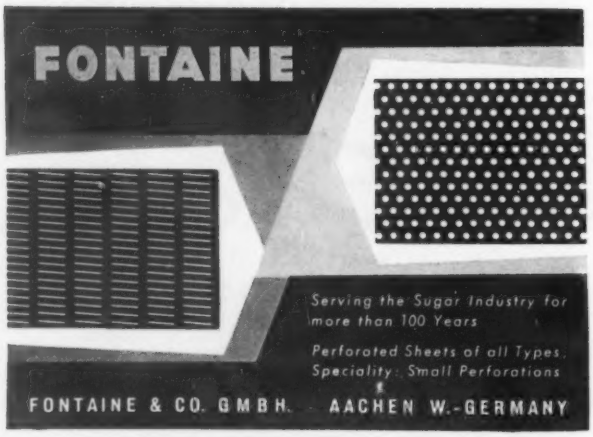
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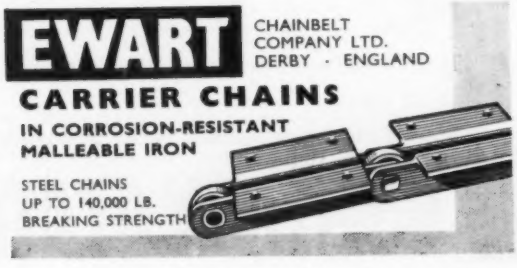

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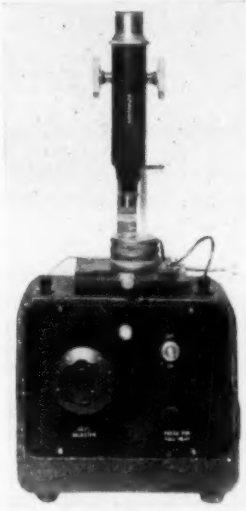

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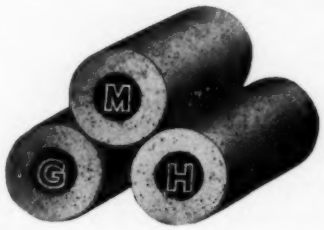

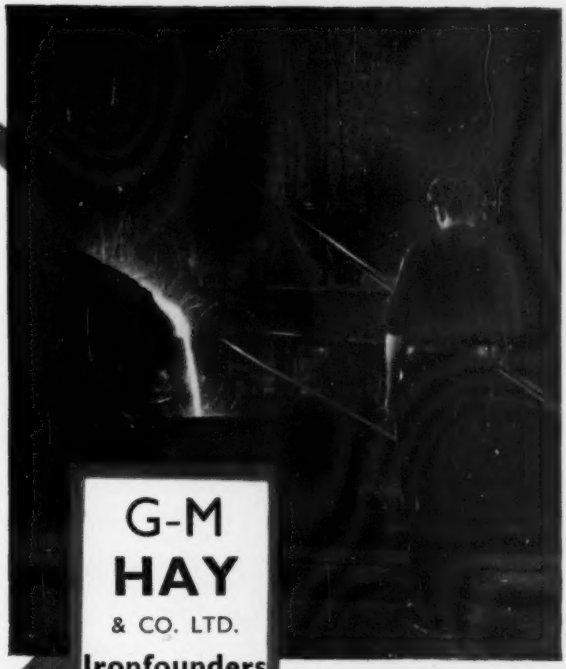

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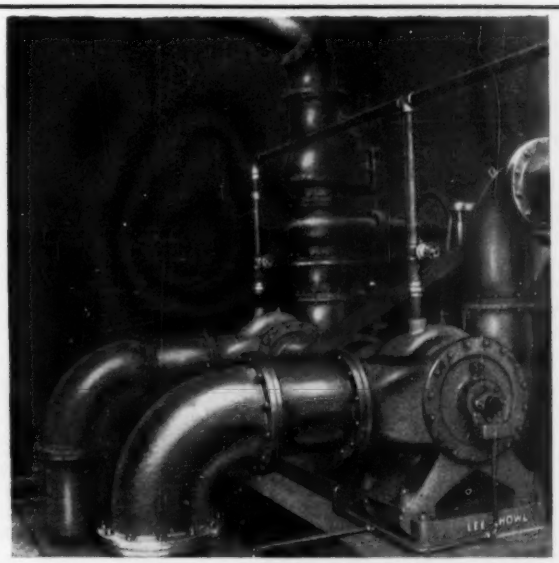

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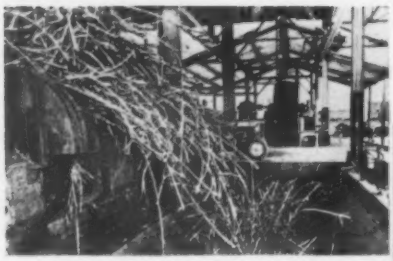

Cane Knives—Carriers—Feeder Tables

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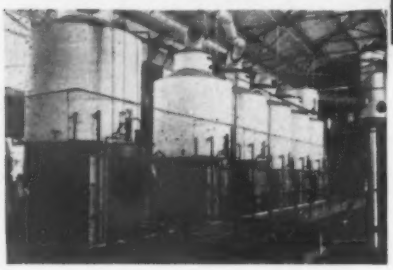

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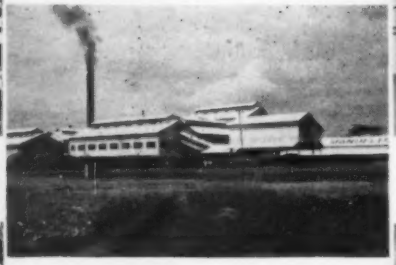

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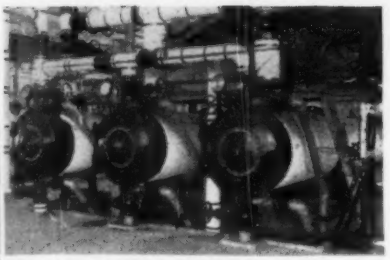

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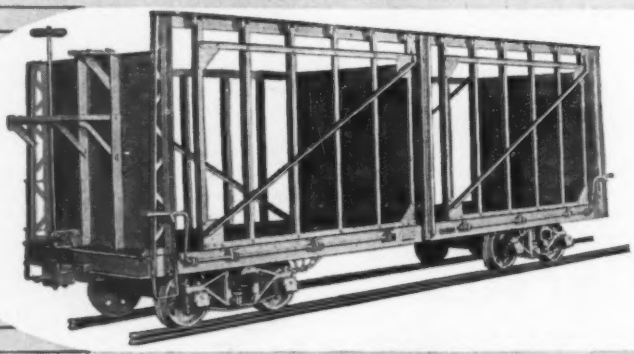

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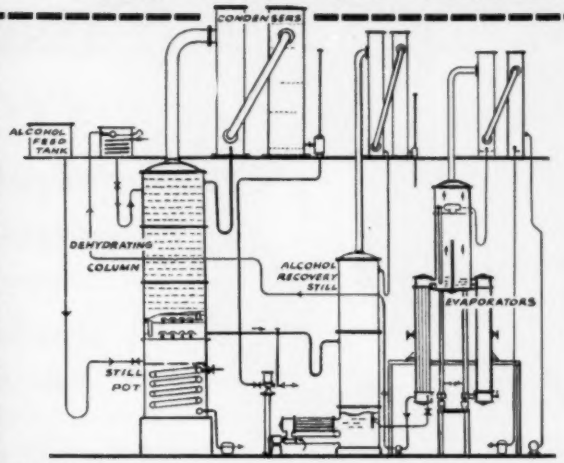

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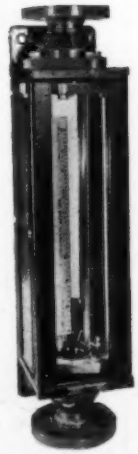

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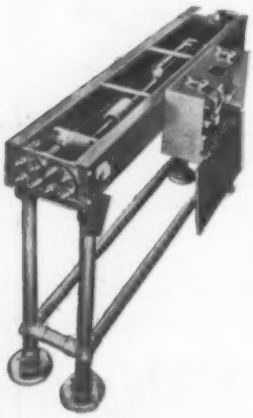

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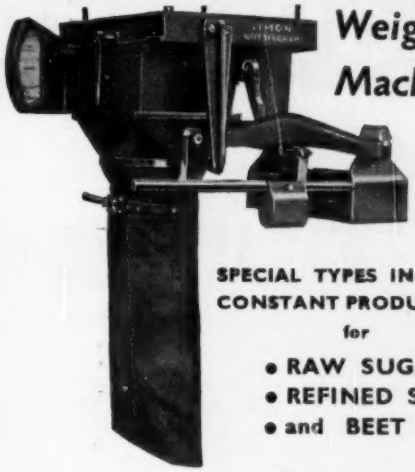

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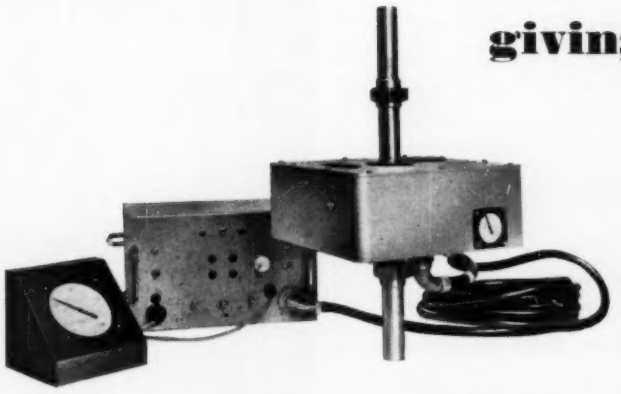

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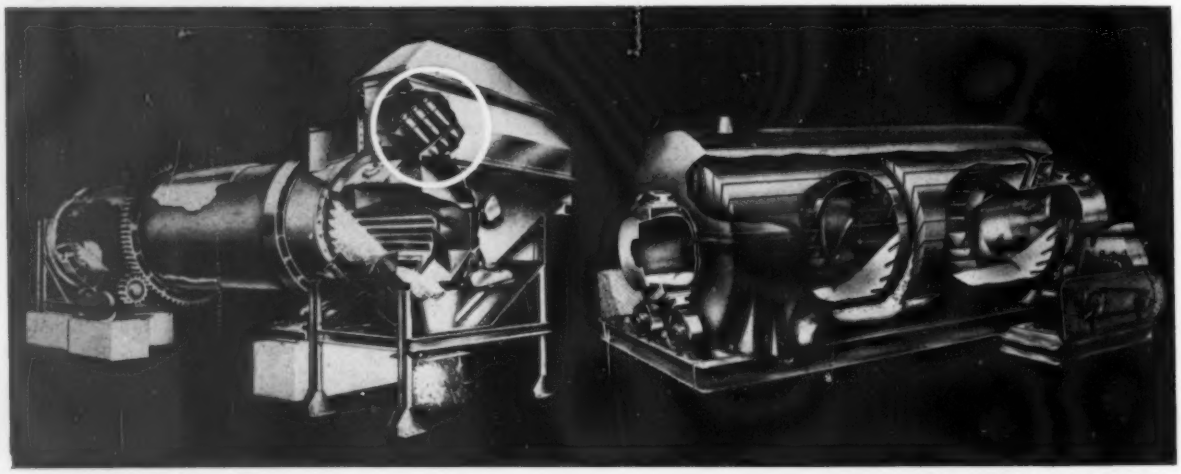

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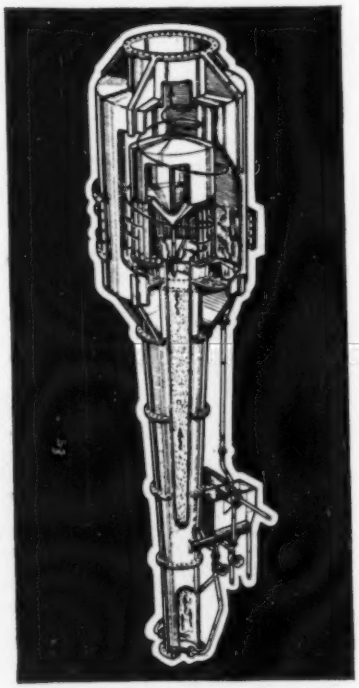

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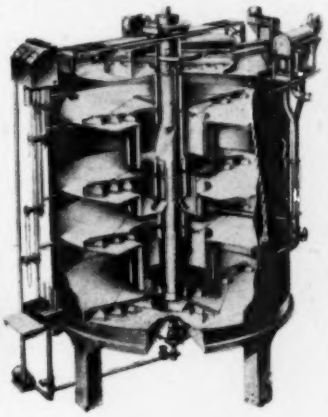

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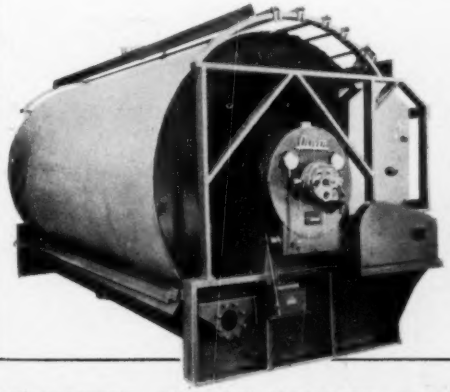

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